United States Department of the Interior

FISH AND WILDLIFE SERVICE

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In Reply Refer To:
08EKLA00-2019-F-0002

APR 15 2019

Scott Smithline
Environmental Manager
Western Federal Lands Division
Federal Highway Administration
610 E. Fifth Street
Vancouver, Washington 98661

Subject: Transmittal of Biological Opinion for Oregon Highway 140 (OR-140) Klamath County Boat Marina to Lakeshore Drive Project, Klamath County, Oregon (Project OR DOT 140 (1))

Dear Mr. Smithline:

This correspondence replies to your request for formal section 7 consultation with the U.S. Fish and Wildlife Service (Service) on the effects of the Oregon Highway 140 (OR-140) Klamath County Boat Marina to Lakeshore Drive project (Project), dated November 5, 2018, and received on November 9, 2018. Your request for consultation is in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.; hereafter referred to as the Act). During the consultation period, the Service received a statement describing changes to the proposed action on March 20, 2019. Our response to your request is based on the November 5, 2018, biological assessment accompanying your letter, the March 20, 2019, changes to the proposed action, various email correspondence, and information in our files.

The Western Federal Lands Division of the Federal Highway Administration (FHWA), in cooperation with the Oregon Department of Transportation and Klamath County, is proposing to widen the pre-existing roadway prism of OR-140 outside of the city of Klamath Falls, Oregon, between mile post 57.0 and mile post 62.6. Additionally, FHWA proposes to construct a wetland mitigation located approximately 3 miles east (across the lake) from mile post 62.6. The mitigation property is a 45 acre parcel adjacent to Upper Klamath Lake, of which 10.09 acres of wetland enhancements will be constructed.

The biological assessment determined that the proposed action would have "no effect" on northern spotted owl (*Strix occidentalis caurina*), yellow-billed cuckoo (*Coccyzus americanus*), grey wolf (*Canis lupus*), North American wolverine (*Gulo luscus*), Applegate's milk-vetch (*Astragalus applegatei*), slender orcutt Grass (*Orcuttia tenuis*), and whitebark pine (*Pinus *albicaulis*), and critical habitat associated with these species. Therefore, these species will not be addressed further in this document.

Bald eagles (*Haliaeetus leucocephalus)* are known to occur adjacent to the Project area. Measures included in your biological assessment restrict activities near nest locations and provide seasonal buffers to minimize disturbance to nesting eagles. Implementation of these measures is consistent with the Service's 2007 *National Bald Eagle Management Guidelines*, which provide recommendations to avoid or minimize adverse impacts to eagles.

The biological assessment also includes a determination that the proposed action "may affect and is likely to adversely affect" the endangered Lost River sucker (*Deltistes luxatus*) and the shortnose sucker (*Chasmistes brevirostris*) and their designated critical habitat. This letter transmits our biological opinion in consideration of the potential effects of the proposed action on the Lost River sucker and shortnose sucker and their critical habitat (enclosed).

Thank you for your efforts to conserve federally protected species. If you have any questions regarding this consultation, please contact Margie Shaffer at 541-885-2516 or margie_shaffer@fws.gov.

Sincerely,

Daniel D. Blake
Field Supervisor

Enclosed:
Biological Opinion for the OR-140(1) Klamath County Boat Marina to Lakeshore Drive project (08EKLA00-2019-F-0002), April 12, 2019.

cc:
Melissa J. Hogan, WFL Environmental Specialist

Biological Opinion on the Oregon Highway 140 Klamath County Boat Marina to Lakeshore Drive Project, Klamath County, Oregon

(Project OR DOT 140(1))

(TAILS # 08EKLA00-2019-F-0002)

April 15, 2019

Prepared by:

U.S. Fish and Wildlife Service
Southwest Region
Klamath Falls Fish and Wildlife Office
Klamath Falls, Oregon

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1 INTRODUCTION

The U.S. Fish and Wildlife Service (Service) has prepared this biological opinion in response to the Western Federal Lands Highway Division of the Federal Highway Administration (FHWA) request for consultation on the effects of the OR-140 Klamath County Boat Marina to Lakeshore Drive project (Project) to the endangered Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*) and their designated critical habitat. The request for consultation is in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.; here after referred to as the Act). The FHWA determined that the Project "may effect and is likely to adversely affect" the Lost River sucker, shortnose sucker, and their designated critical habitat due to habitat modification and disturbance.

Based on the analysis presented in the biological assessment (FHWA 2018, entire) for the Project and the following biological opinion for the Project, the Service concludes that the survival and recovery of the Lost River and shortnose suckers are not in jeopardy as a result of implementation of this Project. Similarly, the Project will not result in destruction or adverse modification of critical habitat.

Implementation of the proposed action is expected to begin the summer of 2020, and will continue over a period of 3 years, with construction completed by the end of the 2022 (M. Hogan, FHWA, personal communication March 20, 2019).

2 CONSULTATION HISTORY

The following is a summary of the communication between FHWA and the Service regarding the proposed action.

March 7, 2017: Stakeholder meeting at Oregon Department of Transportation (ODOT) District 11 Office in Klamath Falls.

May 17, 2017: Presentation of Project at "Kaizen Meeting" (early coordination for complex projects).

June 15, 2017: Project on-site meeting, review eagle nesting sites, and monitoring protocol.

June 15, 2017: Project on-site meeting and review of potential mitigation site.

November 6, 2017: Tour of potential mitigation sites.

August 21, 2018: Draft biological assessment was shared with the Service for comment.

October 26, 2018: Earlier version of the biological assessment was received by the Service but later rescinded by the FHWA due to dredging being added to the Project.

November 9, 2018: Final biological assessment received.

March 13, 2019: Draft BO shared with ODOT/FHWA.

March 20, 2019: Received e-mail from FHWA with changes to the proposed action

3 PROJECT LOCATION AND ACTION AREA

Oregon State Route 140 (OR-140) is part of the "Volcanic Legacy Scenic Byway" that extends from California's Lake Almanor, near Lassen Volcanic National Park, to Crater Lake National park in Oregon. OR-140 also provides access to recreational areas, including the Fremont-Winema and Rogue River National Forests, campgrounds, trails, lakes, boat launches, and snow parks. The various uses associated with OR-140 means the roadway receives heavy use year-round.

The FHWA proposes to widen a 5.6 mile section of OR-140 between mile post 57.0 and mile post 62.6 located northwest of the city of Klamath Falls. The action area is a 200 foot wide corridor that extends east from the base of Doak Mountain, along the western edge of Howard Bay in Upper Klamath Lake, to its intersection with Lakeshore Drive (FHWA 2018, p. 9 & 11). Geary Canal flows under a bridge at the southwest edge of Howard Bay within the action area; however, this bridge will not be impacted as part of this proposed action. This section of roadway provides access to Upper Klamath Lake with pull-outs and a county boat launch with a parking area.

Additionally, FHWA proposes to construct a wetland mitigation site located approximately 3 miles east (across the lake) from the southern end of the action area. The mitigation property is a 45 acre parcel adjacent to Upper Klamath Lake referred to as the Mill mitigation site. The proposed Mill mitigation site action area consists of grading the 45 acre parcel of which, 10.09 acres of wetland enhancements will be constructed for habitat and watershed needs (M. Hogan, FHWA, personal communication March 20, 2019).

The action area for the Endangered Species Act section 7 consultation is defined as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action" (50 CFR section 402.02). Therefore, the action area includes, approximately 2 miles of OR-140 highway along the western edge of Howard Bay, approximately 4 miles of upland highway, and the 45 acre wetland mitigation site (Figure 1).

The proposed widening of OR-140 along Howard Bay includes placing fill material within 70 feet of the current shoreline and construction of six rock points extending 125 feet out from the current shoreline. The addition of fill material into Howard Bay will disturb the bottom substrate of the lake, causing it to move upward into the water column and outward beyond the fill material, this phenomenon is referred to as a "mud wave" (FHWA 2018, p. 23). The mud wave that will result from the addition of fill is expected to extend approximately 50 feet beyond the proposed shoreline. Therefore, the action area includes the 5.6-mile section of OR-140, Howard Bay (including the fill area and the area impacted by the mud wave), Mill wetland mitigation site, and all staging areas.

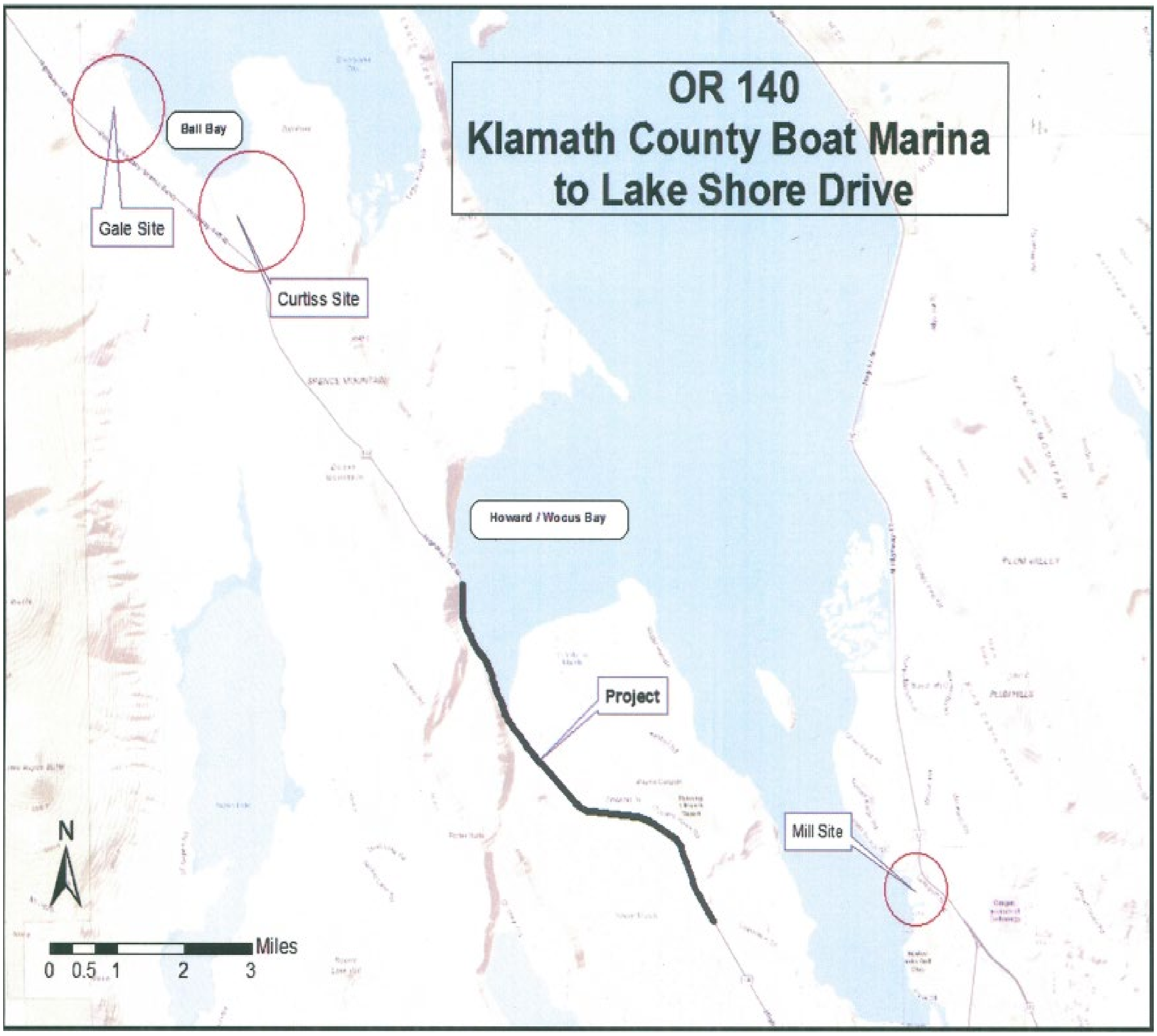


Figure 1. Proposed OR-140 project and the Mill Site wetland mitigation site. Gale site and Curtiss site shown on map were proposed wetland mitigation sites however, they were later removed as landowners were not interested in selling or not ideal habitat (FHWA 2018).

4 PROPOSED ACTION

A federal action means all activities of any kind authorized, funded, or carried out in whole or in part, by federal agencies of the United States (50 CFR 402.02).

The Western Federal Land Highway Division of the FHWA, in cooperation with the Oregon Department of Transportation (ODOT) and Klamath County, proposes widening OR-140 to expand existing travel lanes from 11 feet to 12 feet, widening the road shoulder to 6 feet, realigning the roadway, constructing new embankment along Howard Bay, installing guardrails and rumble strips (where appropriate), constructing stormwater treatment features, and clearing and grubbing upland areas. Approximately 2 miles of the highway widening are along the western edge of Howard Bay in Upper Klamath Lake and approximately 4 miles are upland areas. In addition, the FHWA proposes the construction of a 10.09 acre wetland mitigation site consisting of open water, emergent wetlands, and scrub-shrub wetlands to reconnect the site to the natural hydrology of Upper Klamath Lake.

4.1 CONSTRUCTION ACCESS AND STAGING

The staging areas for all supplies, materials, and equipment for this project will be located in previously disturbed areas within the action area. Entrances and exits for construction and storage areas will be stabilized for use by construction equipment to prevent erosion. Best Management Practices (BMPs) (FHWA 2018, p. 25-28) will be implemented for erosion prevention and sediment control. The implementation of stormwater BMPs will be targeted to protect waterways. All of the appropriate BMPs will be put in place prior to start of construction.

All equipment and vehicles, other than track mounted vehicles will be stored at least 300 feet away from the lake when not in use to prevent hazardous substances from entering the lake. Likewise, all equipment will be inspected for fluid leaks and external material such as, external oil, grease, dirt, and caked mud. External materials will be removed from equipment at least 300 feet away from the lake and any other water way prior to operation. A spill prevention control and countermeasure plan, along with a hazardous waste contingency plan will be prepared and followed on-site at all times during construction activities.

4.2 CONSTRUCTION OF NEW EMBANKMENTS (FILL)

FHWA proposes to construct new embankments along the 2 mile stretch of OR-140 that runs along the western edge of Howard Bay from mile post 57 to mile post 59. The fill will be placed during July 1 through January 31, following the Oregon Department of Fish and Wildlife in-water work guidelines established to protect venerable life stages of important fish species.

The new embankment construction process will begin with the installation of a geogrid in the lake along the current shoreline in the action area. A geogrid is synthetic material used to reinforce soils, compress the lake bottom, and distribute the load as fill is added.

Following the installation of the geogrid, the initial embankment will be constructed with special rock embankment material (SRE). SRE consists of clean, un-weathered, durable, free-draining, and visually well-graded from course to fine, with typical size ranging from 3 to 15 inches. For stability some rock may be larger than 15 inches but no larger than 36 inches. The project includes the construction of an irregular shoreline with six rock points extending approximately 125-feet from the current shoreline be including in the embankment construction. The total estimated fill needed to construct the new embankment is 326,900 cubic yards assuming the existing shoreline elevation (FHWA 2018, p. 24).

Trucks will dump the SRE fill onto turnout areas, then bulldozers will push the SRE fill outward into the lake, on top of the geogrid. The active work platform for placing fill in the lake will move to the completed fill area in the lake once the area has increased to a sufficient surface area above the water level to support construction equipment. Construction of fill areas usually includes the use of scrapers, track hoe, backhoe, bulldozer, and dump trucks.

The new embankment will consist of several layers of SRE material on top of a geogrid system compressing the soft lake bed sediments. Additionally, embankment construction will include cover and protection habitat enhancements for juvenile Lost River and shortnose suckers, such as an increased irregular shoreline, rock points, larger boulders in the base fill, large woody material, and planting of emergent vegetation (bulrush and bur-reed).

The sub-grade and asphalt concrete for the new highway will be constructed, on top of the new embankment, using a combination of equipment such as, graders, bulldozers, track hoes, backhoes, dump trucks, trucks with belly dumps, and rollers. The sub-grade and base material for the new widened shoulders will be constructed in conjunction with the fill slope for the new embankment. Base material consisting of well-graded, fractured rock will be used to compact the sub-grade. After the sub-grade is completed, a leveling course, a base course, and a wearing course of asphalt concrete will be laid to create the new road (FHWA 2018, p. 24). Trucks with belly dumps will most likely be used to deliver material for this project as they have a large carrying capacity. Paving machines will be used to lay the asphalt concrete in place and then rollers will be used to finish compacting the material.

The proposed addition of fill materials into the lake will cause an increase in sedimentation from a mud wave created from the weight of the fill pushing the lake substrate upward and outward from the action area. The resulting sedimentation in the adjacent area will exceed the Oregon Department of Environmental Quality turbidity limits. Prior to construction a turbidity curtain will be installed in the in-water work area of Upper Klamath Lake to minimize and contain the sedimentation resulting from the addition of fill material. A turbidity curtain is designed as a barrier around the action area preventing sediment, turbid water, and other material from spreading beyond the immediate action area and allowing materials to re-settle.

4.3 DREDGING

The biological assessment listed removal of deposited sediments by dredging from the Howard Bay boat launch in the maintenance section. However, dredging was moved from the maintenance section of the biological assessment, as maintenance activities are considered ongoing actions, and dredging in this project is considered a onetime action. The displacement of sediment or mud wave resulting from the addition of embankment fill material could extend to the boat launch. Sediment material deposited and accumulated at the boat launch may obstruct use. Dredging and removing accumulated material will need to occur to clear the Howard Bay boat launch of deposited materials and restore functionality.

Dredging will be conducted from the shore during the in-water work period (July 1 – January 31). The equipment used to clear the boat launch could include a backhoe and/or extended backhoe. Dredged material (lake-bottom sediment) will be transferred to an upland location away from Upper Klamath Lake to prevent material from entering waterways.

4.4 UPLAND ROADWAY CONSTRUCTION

Approximately 4 miles of upland roadway construction will be completed from mile post 59.0 to mile post 62.6 where OR-140 intersects with Lakeshore drive. The work area in the action area will be limited to half mile sections to minimize erosion potential. Following the preparation of the action area by clearing and grubbing of the right-of-way, the initial grading of the cut and fill slopes will begin. The equipment usually involved in constructing cuts and fills include scrapers, track hoes, backhoes, bulldozers, dump trucks and drill rigs. Excess materials from the cut slope construction will be taken to an upland location away from Upper Klamath Lake and other waterways to ensure sedimentation is not increased during stockpiling of material for re-use.

Following the completion of the cut and fill slopes, cross drain culverts within the project area will be constructed, extended, or replaced. However, the existing bridge that Geary Canal flows under will not be impacted during this construction and there are no other streams or creeks that will be impacted within the action area.

The new road base material, sub-grade, and asphalt concrete will be constructed using a combination of equipment such as, graders, bulldozers, track hoes, backhoes, dump trucks, trucks with belly dumps, and rollers. The sub-grade and base material for the new widened shoulders will be constructed in conjunction with the cut and fill slopes. Base material consisting of well-graded, fractured rock will be used to compact the soil sub-grade. After the sub-grade is completed, a leveling course, a base course, and a wearing course of asphalt concrete will be laid to create the new road (FHWA 2018, p. 24). Trucks with belly dumps will most likely be used to deliver material for this project as they have a large carrying capacity. Paving machines will be used to lay the asphalt concrete in place and then rollers will be used to finish compacting the materials.

4.5 STORMWATER TREATMENT FEATURES (DRAINAGE)

Temporary construction BMPs for preventing point source pollution related to construction operation will be in place prior to start of construction. In addition, the FHWA proposes to include permanent stormwater runoff treatment features such as biofiltration swales, vegetated filter strips, ditch relief culverts, riprap, and seeding as part of the OR-140 highway construction.

Biofiltration swales are vegetative sloped ditches with a flat bottom that provide conveyance, infiltration, and removal of pollutants from stormwater runoff. The proposed swales are designed to have at least a 4 foot wide flat bottom containing 18 inches of water quality soil, designed to allow infiltration and trap pollutants, with a minimum hydraulic residence time of 9 minutes during storm events. The Project also proposes the installation of check dams within the biofiltration swales to slow stormwater flows and increase treatment time of storm water.

Vegetated filter strips are planted land areas often situated between the pollution generating impervious surface and a surface waterbody. Stormwater runoff has the potential to carry sediment and other pollutants, either bound with the sediment or dissolved in the water, into Upper Klamath Lake. Vegetated filter strip along the roadway provide water quality protection by reducing the amount of sediment and other pollutants from entering the lake. A minimum 5 foot wide vegetation filter strip will be placed along the lake section of the action area. Normal standard width of a vegetation filter strip to fully treat 40 feet of pavement is 10 feet at a 2% cross slope (FHWA 2018, p. 28). However, a 10 foot vegetation strip would require 28,150 cubic yards of additional fill in Upper Klamath Lake. The proposed 5 foot wide vegetation filter strip will not meet the full level of water quality treatment but is considered to be less detrimental to the ecosystem of Upper Klamath Lake.

Ditch relief culverts are used to disperse water over a greater surface area and minimize concentrated flows. The proposed action calls for current ditch relief culverts to be located and replaced and new culverts to be installed in low areas to provide adequate flow capacity. Similar to swales, ditch relief culverts increase water infiltration and filtration while reducing sedimentation with longer residence time in ditches over a greater surface area.

Riprap is used in erosion control splash pads at culvert inlets, culvert outlets and within roadside ditches to reduce the amount of sediment released with stormwater flows. Ditches with a slope greater than 4 percent and where the installation of culverts is not feasible or practical, will be lined with riprap to form a foundation to prevent erosion. The SRE used in the construction of embankment along Upper Klamath will offer erosion protection to the roadway from wave action.

A native seed mix will be used to seed bare slope during the construction growing season, as erosion prevention and sediment control. Post-construction site revegetation will also be completed during this three-year construction time frame.

4.6 MAINTENANCE

According to FHWA (2018, p. 31), Oregon Department of Transportation and Klamath County road maintenance activities will not require change based on the additional road width resulting from the proposed action. Maintenance activities such as snowplowing, ice removal, mowing, herbicide application, culvert clean outs, and ditch maintenance will function as normal along the wider roadway.

Additional maintenance and monitoring actives at the proposed mitigation site will be performed by the U.S. Forest Service, Restoration Services Team and the Oregon Department of Transportation. The Restoration Services Team will be responsible for seeding, planting, and monitoring during construction (Hogan 2018, pers. comm.). After the construction of the site is completed in 2022, the Restoration Services Team will be responsible for post-construction weed management, monitoring, and maintaining the site for 5 years. The Oregon Department of Transportation will take over monitoring and maintaining the site at the end of this 5 year period and will submit annual reports to the Oregon Department of State Lands and the U.S. Army Corps of Engineers (M. Hogan, FHWA, personal communication March 20, 2019).

4.7 MITIGATION SITE

The expansion of OR-140 in the action area will impact approximately 9.64 acres of open water habitat and four of the seven lake fringe wetlands, totaling 0.15 acres (FHWA 2018, p. 31). Impacted wetlands will be mitigated at a 3:1 ratio and open water impacts will be mitigated at a 1:1 ratio through the restoration of the proposed Mill mitigation site. Approximately 10.09 acres of the Mill mitigation site property (45 acres total) will be used for this mitigation (Figure 2). This mitigation will consist of grading the entire 45 acre parcel, constructing a 9.64 acre open water and emergent wetland, and constructing a 0.45 acre emergent and scrub-shrub wetland to reconnect the natural hydrology of Upper Klamath Lake.

The BMPs employed at the mitigation site are the same as employed for the entire construction project for erosion prevention and sediment control. Prior to moving equipment or beginning any work on the project, a meeting between the FHWA environmental protection specialist, the engineer, and inspector will occur on site, to ensure all parties understand the locations of sensitive biological sites and the measures that shall be taken to protect them. Prior to construction erosion controls will be installed per erosion control plan which includes sediment fencing, wattles, and turbidity curtains. Turbidity curtains will be installed in the in-water work area of Upper Klamath Lake to minimize and contain the sedimentation resulting from blasting and excavation of the dikes.

The proposed wetland mitigation site plan includes improving water quality and fish habitat, reclaiming farmland to create a functioning wetland area (including sediment retention, stabilization, and water bird feeding and nesting habitat), and is expected to expand larval and juvenile rearing habitat for Lost River and shortnose suckers. Mitigation plan goals will be accomplished by removing trash and debris, blasting or excavating to breach dikes and create deeper channels, and mechanically excavating high land areas of the parcel to reconnect them to the hydrology of the lake. Shallow shorelines with large woody material and emergent native vegetation will be established as part of the mitigation plan to create possible habitat for larval and juvenile sucker.

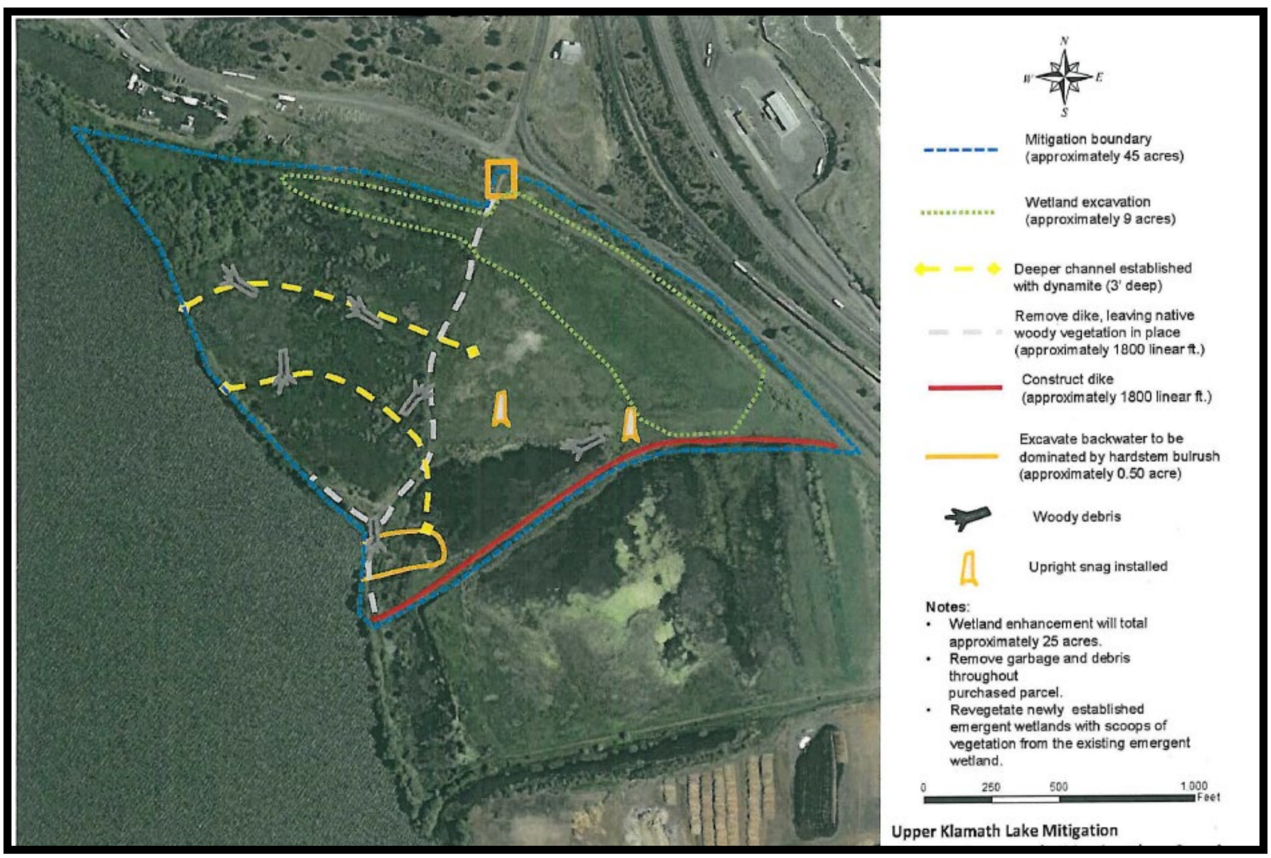


Figure 2. Conceptual plan overview of 45 acre Mill wetland mitigation site (FHWA 2018)

4.8 CONSERVATION MEASURES

FHWA proposed to minimize impacts to endangered Lost River and shortnose suckers, in wetland and open water action areas through avoidance, minimization, and conservation measures incorporated into the project. These measures include (FHWA 2018, p. 30):

1. Reducing shoulder width from the standard 8 feet to 6 feet.
2. Reducing standard roadway slope from 1 vertical: 6 horizontal slope to 1 vertical: 4 horizontal slope in areas of wetlands. The steeper slope will minimize the amount of fill material place in the lake.
3. Minimize wetland impacts by extending guardrails on to the road shoulder
4. Reducing the amount of fill material needed for the Project by installing a geogrid prior to adding fill material to compact lake bottom sediments.
5. Reduce the amount of stormwater flow, sedimentation, and pollutants from entering wetlands and waterbodies by creating adjacent stormwater treatment features.
6. Minimize effects to sensitive fish life stages by completing all in-water work between July 1 and January 31.
7. Minimize construction pollution with BMPs for erosion prevention and sediment control, turbidity curtains to isolate in-water work areas, spill control and countermeasure plan, and hazardous waste contingency plan will be prepared and followed on site at all times during construction activities.
8. Minimize fish capture when installing the turbidity curtains by dragging it from shore outward into position in the lake.
9. Enhance larval and juvenile sucker cover and protection habitat by installing large woody material, large rocks, rock points, and planting vegetation in and around the newly constructed embankment.

5 PURPOSE AND ORGANIZATION OF THIS BIOLOGICAL OPINION

Because the FHWA has determined that the proposed actions may affect and are likely to adversely affect the endangered Lost River and shortnose sucker and their critical habitat, FHWA requested formal consultation with the Service. Formal consultation results in the Service issuing a biological opinion as to whether the proposed action is likely to jeopardize the continued existence of the Lost River and shortnose sucker or to destroy or to adversely modify designated critical habitat. The requirement for all Federal actions to avoid jeopardy and adverse modification is described in section 7(a) (2) of the Endangered Species Act. The regulatory definition of jeopardy and a description of the formal consultation process are provided at 50 CFR 402.02 and 402.14, respectively.

5.1 ANALYTICAL FRAMEWORK FOR THE JEOPARDY DETERMINATION

Section 7(a)(2) of the Endangered Species Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR § 402.02).

The jeopardy analysis in this biological opinion considers the effects of the proposed Federal action, and any cumulative effects, on the range-wide survival and recovery of the listed species. It relies on four components: (1) the *Status of the Species*, which describes the range-wide condition of the species, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which analyzes the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) the *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the species.

5.2 ANALYTICAL FRAMEWORK FOR THE DESTRUCTION OR ADVERSE MODIFICATION DETERMINATION

Section 7(a)(2) of the ESA requires that Federal agencies insure that any action they authorize, fund, or carry out is not likely to destroy or to adversely modify designated critical habitat (CH). A final rule revising the regulatory definition of "destruction or adverse modification" (DAM) was published on February 11, 2016 (81 FR 7214). The final rule became effective on March 14, 2016. The revised definition states:

> "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features."

The DAM analysis in this biological opinion relies on four components: (1) the *Status of Critical Habitat*, which describes the range-wide condition of the CH in terms of the key components (i.e., essential habitat features, primary constituent elements, or physical and biological features) that provide for the conservation of the listed species, the factors responsible for that condition, and the intended value of the CH overall for the conservation/recovery of the listed species; (2) the *Environmental Baseline*, which analyzes the condition of the CH in the action area, the factors responsible for that condition, and the value of the CH in the action area for the conservation/recovery of the listed species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated and interdependent activities on the key components of CH that provide for the conservation of the listed species, and how those impacts are likely to influence the conservation value of the affected CH; and (4) *Cumulative Effects*, which evaluate the effects of future non-Federal activities that are reasonably certain to occur in the action area on the key components of CH that provide for the conservation of the listed species and how those impacts are likely to influence the conservation value of the affected CH.

For purposes of making the DAM determination, the Service evaluates if the effects of the proposed Federal action, taken together with cumulative effects, are likely to impair or preclude the capacity of CH in the action area to serve its intended conservation function to an extent that appreciably diminishes the rangewide value of CH for the conservation of the listed species. The key to making that finding is understanding the value (i.e., the role) of the CH in the action area for the conservation/recovery of the listed species based on the *Environmental Baseline* analysis.

6 STATUS OF THE LOST RIVER AND SHORTNOSE SUCKER

In this section, we assess the condition of the Lost River and shortnose sucker. We describe factors—such as life history, distribution, and population size—which help determine the likelihood of both survival and recovery of the species.

The Lost River suckers (*Deltistes luxatus*) and shortnose suckers (*Chasmistes brevirostris*) are two closely related large-bodied, long-lived, lake-dwelling fishes endemic to the Upper Klamath Basin in central southern Oregon and northern California. Due to the similarities in appearance, distribution, and behavior of the Lost River and shortnose sucker they will be discussed together throughout this document.

6.1 LEGAL STATUS

The Lost River and the shortnose sucker were federally listed as endangered throughout their entire range on July 18, 1988 (USFWS 1988, entire), a recovery plan was finalized in 1993 (USFWS 1993, entire) the plan was revised in 2013 (USFWS 2013a, entire), and final critical habitat designated on December 11, 2012 (USFWS 2012, entire). These "key references" are included here by reference.

6.2 TAXONOMY

Both species are members of the *Catostomidae* family, commonly called suckers. This family of fish is comprised of 76 species and 14 genera, 97 percent of which only occur in North or Central America (Cooke et al. 2005, p. 319). Cope (1879, p. 784) was the first to describe the Lost River sucker (*Deltistes luxatus*) from Upper Klamath Lake specimens as *Chasmistes luxatus*. Because of the unique triangular gill rakers that are not found in any other closely related sucker species, the Lost River sucker was elevated as the monotypic genus *Deltistes* in 1896 (Seale 1896, p. 269). The Lost River sucker is currently recognized as the only surviving member of the genus *Deltistes* (Nelson et al. 2004, p. 79). The shortnose sucker was described by Cope (1879, p. 784-785) as *Chasmistes brevirostris*.

At the time of listing hybridization was identified as a threat for the species. Data suggests that hybridization among the four Klamath basin suckers (Lost River sucker, shortnose sucker, Klamath largescale sucker, and Klamath smallscale sucker) does occur (Dowling, T. 2005, entire, Tranah and May 2006, entire). Morphological and molecular genetic research indicates that hybridization occurs particularly between shortnose sucker and Klamath Largescale sucker throughout the range of shortnose sucker (Markle, Douglas F. et al. 2005, entire, Tranah and May 2006, entire). Data suggests that introgressive hybridization between suckers, especially shortnose and Klamath largescale suckers, is consistent with patterns of historical hybridization, which is not uncommon for the sucker family (Dowling, T. E. and Secor 1997, entire, Dowling 2005, entire, Tranah and May 2006, entire). Despite hybridization, all species continue to maintain characteristic morphological traits, although intermediate forms do occur as well (Dowling 2005, entire, Markle et al. 2005, entire).

6.3 PHYSICAL DESCRIPTION

Both the Lost River and the shortnose sucker are members of a group of suckers (Family *Catostomidae*) which predominantly utilize lake environments, typically only leaving lakes during spawning migrations. Lake suckers are characterized as having terminal or sub-terminal mouths.

The Lost River sucker is generally distinguished by a relatively large size and elongate body and sub-terminal mouth with a deeply notched narrow lower lip (Scoppettone, G. G. and Vinyard 1991, p. 359). Coloration is typically dark on back and sides of the body fading to yellow or white on the belly. The bodies of spawning adults are extensively covered with small white nodules known as tubercles. Lost River sucker are relatively large fish that can grow to about 2.6 feet long and weigh up to 9.9 pounds.

The shortnose sucker is generally distinguished by an oblique, terminal mouth and thin fleshly lips with very few papillae (small round bumps). The lower lip is deeply notched, giving the appearance of two separate lobes. The head and overall body size of the shortnose sucker is smaller than the Lost River sucker. They have similar coloration to the Lost River suckers with typically dark back and sides with a silvery or white belly. Shortnose sucker can grow to about 2.1 feet (Moyle 2002, p. 203-204).

6.4 HISTORIC AND CURRENT RANGE

The Lost River and shortnose sucker are endemic to the upper Klamath River Basin, including the Lost River and areas in and around Upper Klamath Lake and its tributaries (Figure 3) (Cope 1879, p. 784-785). Sparse records make it difficult to know precisely which tributaries and bodies of water these species historically occupied, but these species are likely to have occurred in all the major lakes of the upper basin (Upper Klamath Lake, Lower Klamath Lake, Tule Lake, Lake Ewauna, and Clear Lake Reservoir) as well as the major tributaries of these water bodies for spawning and rearing (including the Williamson River, Sprague River, Wood River, Lost River, Willow Creek, and the Klamath River above Lower Klamath Lake). Additionally, the species likely utilized many smaller streams throughout the upper basin. Suckers were also known to spawn in great numbers at several springs and seeps along the eastern shoreline of Upper Klamath Lake, including Barkley (Bendire 1889, p. 444), and likely spawned at other spring-dominated areas in the northwestern corner of the lake, including Harriman, Crystal, and Malone Springs.

Prior to listing significant amounts of suitable habitat were lost or modified due to the conversion of wetlands for agricultural uses and development which restricted sucker distribution. In addition, several migration barriers were constructed throughout the range of the species, including the Link River Dam (1921), Clear Lake Dam (1910), Wilson Diversion Dam (1912), Malone Diversion Dam (1921), Anderson-Rose Dam (1921), Chiloquin Dam (1914), the railroad (1909), and many smaller structures (BOR 2000, entire).

At the time of listing, Lost River and shortnose sucker were known from Upper Klamath Lake, its tributaries, and outlet (Klamath County (Co), Oregon), as well as Iron Gate Reservoir (Siskiyou Co., California), J.C. Boyle Reservoir (Klamath Co., Oregon), and a “substantial” population of shortnose sucker in Copco Reservoir (Siskiyou Co., California) on the Klamath

River (USFWS 1988, p. 27130). Remnants and/or highly hybridized populations were also documented to occur in the Lost River system (Klamath Co., Oregon, and Modoc and Siskiyou Co., California) including both species in Clear Lake Reservoir (Modoc Co., California). However, it was presumed that Lost River suckers populations in Sheepy Lake, Lower Klamath Lake, and Tule Lake (Siskiyou Co., California) had been "lost" (USFWS 1988, p. 27130). Although not explicitly stated, shortnose sucker within Gerber Reservoir (Klamath Co., Oregon) were likely part of a "highly hybridized populations" in the Lost River Basin referenced in the listing.

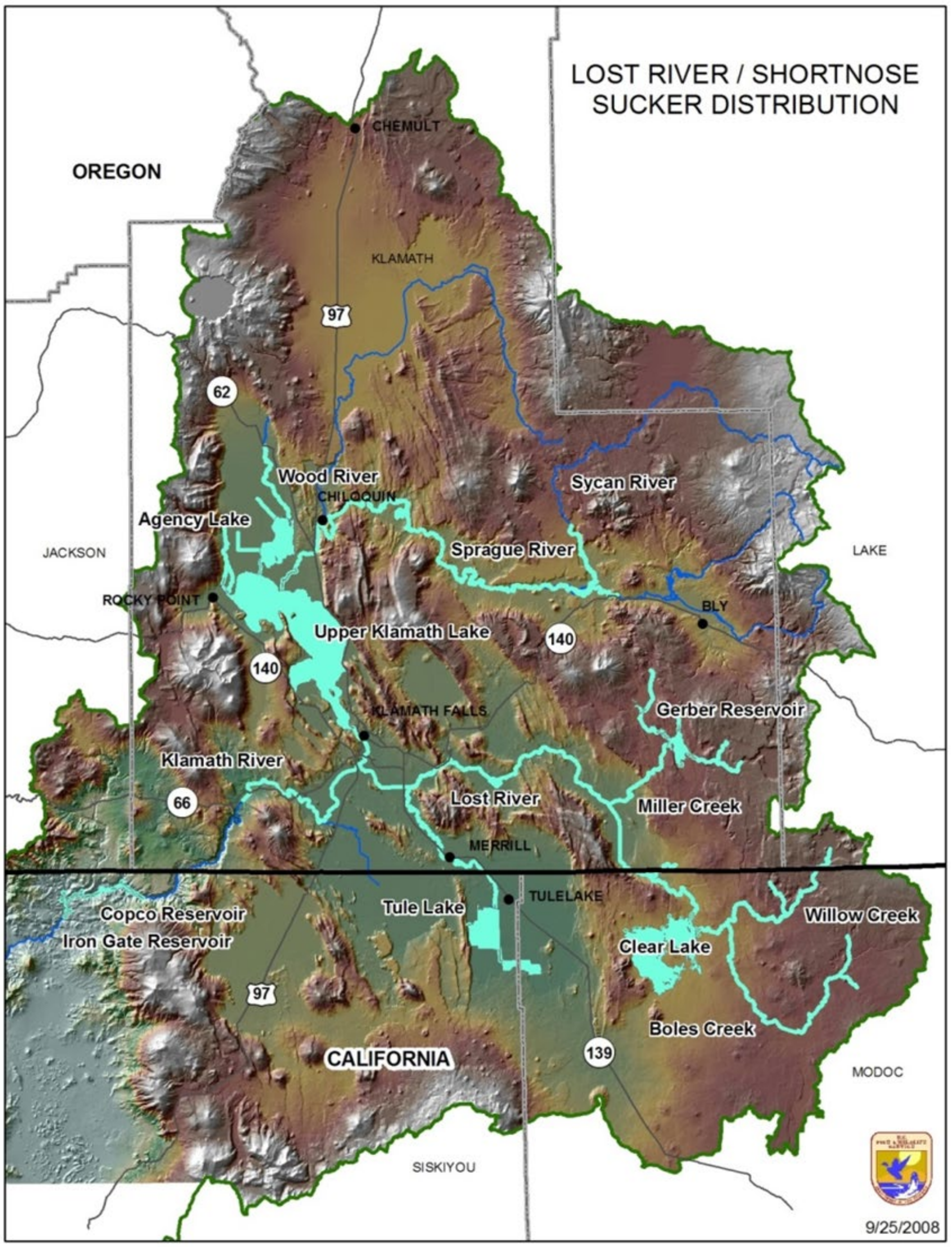


Figure 3. The Lost River and shortnose sucker are endemic to the lakes and rivers of the Upper Klamath

Basin in south, central Oregon and north, central California. Lower Klamath Lake and Sheepy Lake are not depicted on the map because populations no longer occur there.

Two major improvements were made to habitat availability and connectivity in the late 2000s. The removal of Chiloquin Dam in 2008 was the first improvement to habitat connectivity, which particularly benefits migrating adults and larvae during the spawning period. Before removal of this dam, approximately 75 miles of potential spawning habitat and migration corridor along the Sprague River could only be access by migrating adults via an impaired fish ladder. The second major improvement was the restoration of the freshwater marsh where the Williamson River entered Upper Klamath Lake, known as the Williamson River Delta. Approximately 6,000 acres of potential rearing habitat for larvae and juveniles were reconnected to the lake and river when levees were breached in 2008 and 2009.

At approximately 64,000 acres (26,000 hectares), Upper Klamath Lake is the largest remaining contiguous habitat for endangered suckers in the Upper Klamath Basin. Upper Klamath Lake is a natural lake that was dammed in 1921 to allow for management of lake elevations both higher and lower to support irrigation deliveries. Approximately 70 percent of the original 50,400 acres (20,400 hectares) of wetlands surrounding the lake, including the Wood River Valley, was diked, drained, or significantly altered between 1889 and 1971 (Gearhart et al. 1995, p. 7). Spawning aggregations at numerous locations within the Upper Klamath Lake system have disappeared, but Lost River sucker continue to use two spawning locations in relatively large numbers: the Williamson River and the eastern shoreline springs, and Upper Klamath Lake contains the largest remaining population of Lost River sucker by far. Shortnose sucker are only known to spawn in significant numbers in the Williamson River.

Spawning in the Williamson River and the Sprague River, its major tributary, occurs primarily in a 7.8-km (4.8-mile) stretch continuing from the Williamson River downstream of the confluence with the Sprague to the historical Chiloquin dam site on the Sprague River. Although the Chiloquin dam was removed in 2008, only small numbers of suckers migrate beyond the historical dam site to spawn (Martin et al. 2013, p. 10).

6.5 LIFE HISTORY

Lost River and shortnose sucker are large bodied, long-lived species, with maximum ages of up to 57 and 33 years respectively (Buettner and Scoppettone 1991, p. 20-21, Terwilliger et al. 2010, p. 244). Juveniles grow rapidly until reaching sexual maturity sometime between four and nine years of age for Lost River sucker and between four and six years of age for shortnose sucker (Perkins, Scoppettone et al. 2000, p. 20-21). On average, approximately 90 percent of adults of both species survive from year to year, which enables populations to persist through periods with unfavorable spawning or recruitment conditions (Hewitt et al. 2018, p. 17, 21). Upon achieving sexual maturation, Lost River sucker are expected to live on average 12.5 years based on annual survival rates (Hoenig 1983, entire, USFWS 2013, p. 12). Similarly, shortnose sucker adults are estimated to live on average 7.4 years after having joined the adult population. Thus, for those individuals surviving to adulthood, we expect an average total life span of 20 years for Lost River sucker and 12 years for shortnose sucker, based on the average time to maturity and average adult life spans, with the expectation of some distribution around this mean.

Lost River Sucker females produce 44,000 to 236,000 eggs per year and shortnose sucker females produce 18,000 to 72,000 eggs per year (Buettner and Scoppettone 1990, p. 46, Perkins et al. 2000, p. 21). Not all eggs are expected to survive to become larvae (e.g., due to lack of fertilization, improper development). Only a small percentage of larvae are expected to survive to become juveniles and even fewer survive to become adults. No direct measurements of this metric have been made for these species, a generally excepted value of larval mortality for freshwater fish to reach the juvenile stage is approximately 96.4 percent (Houde, Edward D. 1989, p. 31, Houde, E. D. and Bartsch 2009, p. 479). The Service believes that the development of shortnose sucker eggs is similar to Lost River sucker development, which has been studied more extensively. Lost River sucker eggs hatch around 8 days after fertilization, and then emerge (swim-up) from the gravel approximately 10 days after hatching (Coleman et al. 1988, p. 27-28).

Lost River and shortnose suckers can generally be classified into five life stages and behaviors that occur at various times throughout the year: migration, spawning, larval, juvenile, and adult. The timing of occurrence of each life stage is similar between the two species, with the main difference occurring during spawning and incubation.

6.5.1 Migration

To complete their life cycle Lost River and shortnose sucker require distinct growth and spawning habitats. Growth occurs in the lakes of the Upper Klamath Basin, and spawning habitat is typically found in the tributary rivers to these lakes. However, a subset of Lost River sucker use lakeshore springs (groundwater upwelling) as their spawning habitat in Upper Klamath Lake. Small numbers of shortnose sucker are also detected at these lakeshore sites (Hewitt et al. 2017, p. 24), but the low numbers suggest that they are likely just vagrant individuals not attempting to spawn. Because most individuals utilize distinct growth and spawning habitats, they must complete a spawning migration to reproduce.

Adult Lost River and shortnose sucker in Upper Klamath Lake appear to strongly cue on water temperature to initiate spawning migrations up the Williamson River, which is the only tributary to Upper Klamath Lake with large spawning populations. Migrations begin only after appropriate water temperatures have been achieved: 10°C (50°F) for Lost River sucker and 12°C (54°F) for shortnose sucker (Hewitt et al. 2017, p. 11 & 24), and decreasing temperatures can reduce numbers of individuals migrating upstream (Hewitt et al. 2014, p. 36-37).

Successful migration to spawning habitats can be limited by hydrology conditions. In Upper Klamath Lake, access to the Williamson River does not appear to be affected by river flows or lake elevations, but access to and/or suitability of the lakeshore springs habitat can be reduced by shallow depths or dewatering at springs due to low lake elevations (Burdick, Summer M. et al. 2015, entire).

6.5.2 Spawning

Currently, within Upper Klamath Lake the listed suckers primarily spawn in the lower Williamson and Sprague Rivers although some spawning occurs in shoreline spring habitat. In Upper Klamath Lake, while some spawning occurs in March, the bulk occurs in April and early May (Hewitt et al. 2014, p. 9). Fertilized eggs settle within the top few inches of the substrate until hatching, around one week later.

Generally, individuals of both species appear to spawn every year in Upper Klamath Lake. Spawning activity is typically observed over mixed gravel and cobble substrates, typically in water depths less than 0.46 m (1.5 ft) ranging from 0.12 to 0.70 m (0.4 to 2.3 ft) in rivers and shoreline springs (Buettner and Scoppettone 1990, p. 44-45). Gravel is rock ranging in size from 2-64 millimeter (mm) in diameter, and cobble ranges in size from 65-256 mm in diameter. Eggs require relatively open substrate that permits sufficient aeration but still restrict access from potential predators. These conditions are also important for the elimination of waste materials from the egg during incubation. Eggs need some protection, such as small spaces in gravel, against potential predators and disease, although there are no data to clarify what conditions are optimal. The small spaces between gravel pieces in the substrate help to restrict access from potential predators and limit the number of eggs that can randomly clump together, which could reduce the spread of diseases such as certain fungi that can grow on developing eggs.

6.5.3 Larvae

Generally, larvae spend little time in their natal streams after swim-up, but quickly enter "the drift" by passively riding the current downstream to the lakes. Larval movement away from the spawning grounds begins in late April and is completed by early July. This downstream movement mostly occurs at night near the water surface (Buettner and Scoppettone 1990, p. 46, Tyler et al. 2004, p. 8-15). During the daytime larvae reside in the slack waters along the periphery of the stream (Cooperman and Markle 2003, p. 1149). In the Upper Klamath Lake system, larvae can move from the natal site to the lake (approximately 12 miles) in as little as a day following swim-up (Cooperman and Markle 2003, p. 1149).

Once in the lake, shortnose larvae predominately inhabit near-shore areas within or adjacent to emergent vegetation (Cooperman and Markle 2003, entire), but Lost River larvae tend to occur more often in open water habitat than near vegetated areas (Burdick, Summer M. and Brown 2010, p. 19). During this period, larvae density is generally higher within and adjacent to emergent vegetation than in areas devoid of vegetation (Cooperman and Markle 2003, p. 370). Emergent vegetation provides cover from predators and habitat for prey such as zooplankton, macroinvertebrates, and periphyton (Crandall 2004, p. 412). Such areas also may provide refuge from wind-blown current and turbulence, as well as areas of warmer water temperature, which may facilitate larval growth (Cooperman et al. 2010, entire).

6.5.4 Juvenile

Larvae transform into juveniles by mid-July at about 1 inch in total length, and they then transition from predominantly feeding at the surface to feeding near the lake bottom (Markle, D. F. and Clauson 2006, p. 496). In Upper Klamath Lake juvenile suckers primarily use relatively shallow (less than approximately 3.9 feet) vegetated areas, but may also begin to move into deeper, un-vegetated off-shore habitats (Bottcher and Burdick 2010, p. 12-14). One-year old juveniles occupy shallow habitats during April and May but may afterwards move into deeper areas along the western shore of Upper Klamath Lake until dissolved oxygen levels become reduced (Bottcher and Burdick 2010, p. 12). Age-0 juveniles do not appear to have a strong preference for a particular substrate size or type in Upper Klamath Lake (Burdick, S. M. et al. 2008, p. 424-426), but may be slightly more common over sand and mud compared to soft organic mud or silt bottoms (Buettner and Scoppettone 1990, p. 30 & 51). Age-0 sucker are defined as individuals younger than 1 year. Little is known about the ecology of older (ages 1-4) juvenile suckers.

6.5.5 Sub-adult and Adult

Sub-adults are individuals who display all of the characteristics of adults with the exception of reproductive maturity. Juveniles grow rapidly until reaching sexual maturity sometime between age four and nine years of age for Lost River sucker and between four and six years of age for shortnose sucker (Buettner and Scoppettone 1990, p. 21, Perkins et al. 2000, p. 20-21). The Service assumes that sub-adults utilize habitats similar to adults. Adult Lost River and shortnose sucker use Upper Klamath Lake as their primary habitat for feeding and growing; they migrate to spawning habitats during spring as described in Section 6.5.1 and 6.5.2. In their growth habitat, adult suckers require adequate food, water quality, and refuge from predation. Adult Lost River and shortnose suckers inhabit water depths of 3.3 to 14.8 feet, but appear to prefer depths from 4.9 to 11.2 feet (Peck 2000, p. 3, Banish et al. 2009, p. 160). Lost River and shortnose sucker adults are widely distributed in Upper Klamath Lake during the fall and winter, but during the summer tend to congregate in and around areas of relatively better water quality (Banish et al. 2009, p. 159-167).

6.6 FOOD HABITS

As larvae, both suckers are provisioned with a yolk sac that maintains them for roughly the first 3 weeks after hatching. The initial feeding behaviors tend to be surface oriented, but gradually shift to a more benthic feeding pattern as they become juveniles (Markle and Clauson 2006, p. 496). Little specific information is available on the diet of Lost River and shortnose sucker adults. The Service believes that their morphology and diets are similar to closely related species. *Chasmistes* species, including shortnose sucker, have terminal or sub-terminal mouths and branched gill rakers (Miller and Smith 1981, p. 7), which are presumed to be adaptations for straining zooplankton from the water column (Miller and Smith 1981, p. 1, Scoppettone and Vinyard 1991, p. 359). *Deltistes* species such as the Lost River sucker, have triangular gill rakers and mouths oriented more ventrally, which suggests that they are more dependent on benthic organisms such as, macroinvertebrates. The limited data available on stomach contents from suckers in Clear Lake corroborate the affinity of shortnose suckers for zooplankton and the dependence of Lost River suckers on benthic invertebrates (Scoppettone, G. et al. 1995, p. 31-32).

6.7 POPULATION ABUNDANCE AND DYNAMICS

The wide-ranging behavior, expansive habitat, and rarity of these species make obtaining accurate population estimates challenging. However, long-term monitoring using capture-recapture methods provide accurate information on relative changes in abundance (Hewitt et al.

2018, entire), and abundance can be roughly estimated based on the size of catches and the proportion of individuals that are tagged in annual sampling.

Upper Klamath Lake contains the largest remaining populations of both Lost River and shortnose sucker with rough estimates of abundance (given portions tagged and remote detection) of approximately 100,000 adult Lost River sucker river-spawners, 8,000 adult Lost River sucker shoreline-spring-spawners, and 19,000 adult shortnose sucker (Hewitt et al. 2014, p. 16). However, in 2018, these estimates were much lower: 32,000, 7,900, and 7,200, respectively (D. Hewitt, USGS, personal communication August 16, 2018). Overall, the populations in Upper Klamath Lake are characterized by high annual survival of adults (Hewitt et al. 2018, p. 12, 17, 21). These adults spawn successfully and produce larvae, but few juveniles survive their first year, and captures of individuals 2-6 years old is exceedingly rare (Burdick, S. M. and Martin 2017, p. 30). Similarly, there has not been evidence of significant numbers of new individuals joining the adult spawning populations since the late 1990s, and the lack of significant recruitment has led to sharp declines in population sizes (Hewitt et al. 2018, p. 14, 20, 24)

Survival of adult Lost River and shortnose sucker in Upper Klamath Lake varied little over the past decade. Annual adult survival rates of the shortnose sucker in Upper Klamath Lake appear to vary more than the Lost River sucker, but adult survival for both species in Upper Klamath Lake appears to have been relatively stable since high quality estimates became available in the early 2000s (Hewitt et al. 2018, p. 12, 17, 21). Adult Lost River sucker in Upper Klamath Lake average approximately 93% survival annually (Hewitt et al. 2017, p. 15, 21). The approximate average adult shortnose sucker annual survival in Upper Klamath is slightly less at 87% (Hewitt et al. 2017, p. 28). However, the most recent data indicate that survival from spring 2016 to spring 2017 was low for both species, in some cases lower than has been observed during the period with robust estimates. For shortnose sucker, estimated 2016 survival was 77% for females and 74% for males. Estimated survival for both sexes for Lost River sucker spawning in the Williamson River was 78%, and it was 85% for Lost River sucker spawning at the lakeshore springs (D. Hewitt, USGS, personal communication August 16, 2018). Additionally, an adult die-off was observed during the summer of 2017 containing at least hundreds of individuals, outside the period captured by these estimates, but data to resolve whether the die-off event influenced annual survival rates will not be available until later in 2019 because survival estimates are confounded with detection probabilities in the final interval for the survival model.

Juvenile mortality and the consequent lack of recruitment of new individuals into the adult populations have led to steep declines in Lost River and shortnose sucker populations in Upper Klamath Lake. Although there is uncertainty in the rates of decline, the best available estimates indicate that the Lost River sucker lakeshore springs spawning population declined by approximately 56 percent for females and 64 percent for males between 2002 and 2015 (Hewitt et al. 2018, p. 10). The decline in the Williamson River Lost River sucker population is more difficult to assess due to sampling issues specific to that population (Hewitt et al. 2018, p. 25-26), but it is likely that the population dynamics are similar to those of the shoreline springs population. The shortnose sucker population in Upper Klamath Lake has also declined substantially since 2001, losing approximately 77 percent of females and 78 percent of males between 2001 and 2016 (Hewitt et al. 2018, p. 19).

Recent Lost River sucker and shortnose sucker size distribution trends reveal that the adult spawning populations within Upper Klamath Lake are comprised mostly of similar-sized, similar-age relatively old individuals. Median lengths of individuals of both species in Upper Klamath Lake generally increased since the 1990's as new recruits continued to mature, but since about 2010 size distributions have been more or less stable among years (Hewitt et al. 2018, p. 19, 22-23, 27, 29). This indicates that few new individuals are joining the adult populations. The fish recruited in the 1990s are now approximately 28 years old and are well beyond the average life span of 12 years for the shortnose sucker and equal to that of 20 years for the Lost River sucker.

The effects of senescence on the survival and reproduction of these two species are unknown at present, but the populations in Upper Klamath Lake are clearly aging (Hewitt et al. 2018, p. 15, 18, 21). The low recent survival rates could be an early signal that senescence is occurring leading to increased mortality rates and accelerated population declines. Additional years of survival data will help to resolve whether the low survival reveals increased mortality of aging individuals or unique environmental conditions to that year.

Lost River sucker also spawn successfully at groundwater seeps along the Upper Klamath Lake margin. No robust estimates of larval production at these sites exist but given the number of Lost River sucker females and average fecundity, it is likely that millions of larvae hatch annually, even with the expected high mortality of eggs. There is typically access to these areas between February and May; however, lake elevations lower than approximately 4141.40-4142.0 ft (1262.3-1262.5 m) reduce the number of spawning individuals and the amount of time spent on the spawning grounds. Upper Klamath Lake elevations less than 4142.0 ft (1262.5 m) occurred by May 31 in six years between 1975 and 2017, which is equivalent to 14 percent of spawning seasons. Thus, lake elevations have the potential to negatively impact spawning for Lost River sucker, but this has rarely occurred over the last 43 years.

Although numerous larvae are produced annually, the number of juveniles captured during sampling efforts is rather low and typically decreases to nearly zero in late summer. Very few individuals are captured as age-1 or older (Burdick and Martin 2017, p. 30), suggesting complete cohort failure each year. The declines in captures commonly occur during the periods with the most degraded water quality conditions in Upper Klamath Lake, but a clear empirical link between water quality parameters and mortality rates is not conclusively established. The specific causes of repeated cohort failure at the juvenile stage are a critical uncertainty challenging recovery because juvenile mortality is the primary factor that contributes to the low resilience of both Lost River sucker and shortnose sucker populations in Upper Klamath Lake.

Even though viable eggs and larvae are produced each year, there is a lack of recruitment of new adults into Upper Klamath Lake sucker populations, which continue to exist only because of their long life. Although we do not know specifically how this current uniform age distribution compares to historical conditions, healthy adult populations of long-lived species should generally possess multiple reproducing year-classes. Both species are expected to become extirpated from Upper Klamath Lake without significant recruitment, but the current dynamics are particularly untenable for the shortnose sucker, and without substantial recruitment in the next decade, the population will be so small that it is unlikely to persist without intervention (Rasmussen, J. E. & Childress, E. S. 2018, p. 586).

6.8 REASONS FOR LISTING AND THREATS

6.8.1 Reasons of Listing

The following discussion is a brief summary of the interacting influences of physical, chemical, and biological factors that continue to threaten the Lost River and shortnose sucker status. In determining whether to list, delist, or reclassify (change from endangered to threatened status, or vice versa) a species under section 4(a) of the ESA, we evaluate five major categories of threats to the species: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence. The following is a summary of factors that led to Lost River and shortnose sucker listing (USFWS 1988, p. 27130) and that were addressed in the most recent 5-year status reviews for the Lost River and shortnose sucker (USFWS 2013b, entire, USFWS 2013c, entire).

6.8.2 Habitat Loss

Loss and alteration of habitat (including spawning and rearing habitats) were major factors leading to the listing of Lost River and shortnose suckers. As noted above, suckers utilize a spectrum of aquatic habitats across their life cycle, including river or stream habitats, open water lake habitats, and the wetlands area along banks and shores. Negative impacts and alterations to each of these different habitats have occurred and impacted the population dynamics of this species. Area of suitable habitat has drastically declined due to conversion of wetlands for agricultural use and construction of irrigation and hydroelectric facilities, both of which drained lakes and wetlands, created barriers preventing access to spawning habitat, and caused fish mortality by entrainment.

Barriers that limit or prevent access to spawning habitat were identified as a threat at the time of listing. Chiloquin Dam was cited as the most influential barrier because it restricted access to potentially 95 percent of historic river spawning habitat in the Sprague River. This dam was removed in 2008, improving access to approximately 75 miles of river for spawning and migration. As of 2013, it did not appear that removal of the dam markedly increased the number of listed suckers (Lost River sucker and shortnose sucker) moving into the higher reaches of the Sprague River (Martin et al. 2013, p. 10). Many other large and small diversion structures remain throughout the range of these species including in the Sprague River.

Another equally important barrier is limited hydrologic connection to spawning or rearing habitat, often resulting from an interaction of irrigation diversions and climate. For example, the amount of suitable shoreline spring spawning habitat in Upper Klamath Lake is significantly affected by even minor changes in lake elevation (Burdick et al. 2015, entire). Several spring-spawning populations, including Tecumseh Springs, Big Springs, and Barkley Springs, have been lost or significantly altered, in part due to reduced connectivity (Andreasen 1975, entire, National 2004, entire, USFWS 1988, p. 27130).

Historically, wetlands comprised hundreds of thousands of hectares throughout the range of the species, some of which likely functioned as crucial habitat for larvae and juveniles. Other wetlands may have played vital roles in the quality and quantity of water. Loss of ecosystem functions such as these, due to alteration or separation of the habitat, is as detrimental as physical loss of the habitat. For example, increases in sediment input to the lake and occurrence of the cyanobacteria *Aphanizomenon flos-aquae* coincide with modification of riparian and wetland areas associated with Upper Klamath Lake (Bradbury et al. 2004, p. 163-164). In Upper Klamath Lake, approximately 72 percent of the original 60,000 acres of wetlands surrounding Upper Klamath Lake, including the Wood River Valley, was diked, drained, or significantly altered between 1889 and 1971 (Akins 1970, p. 76). Additionally, of the approximately 25,141 acres of wetlands still connected to Upper Klamath Lake, relatively little function as rearing habitat for larvae and juveniles, partly due to lack of connectivity with current spawning areas and habitat alterations.

Habitat connectivity and availability was improved through the restoration of the freshwater marsh where the Williamson River entered Upper Klamath Lake, known as the Williamson River delta. Approximately 2,500 hectares (6,000 acres) of potential rearing habitat for larvae and juveniles were reconnected to the lake and river when levees were breached in 2008 and 2009.

Certainly not all modification or curtailment of sucker habitat is solely from anthropogenic causes; climatic trends, resulting from both anthropogenic causes and natural variation, also play an important role. Since 1960, eight of the 10 lowest inflows into Upper Klamath Lake occurred between 1991 and 2009 (USFWS 2013, p. 27). Upper Klamath Lake levels are affected by drought, because it is shallow (average depth in summer = 7.1 feet) and because during droughts larger irrigation diversions are needed to offset low soil moisture in agricultural fields.

6.8.3 Harvest and Collection

Overharvest was cited as contributing to declining population levels, particularly for Lost River sucker, prior to listing. Shortnose sucker were not targeted by recreational fishing prior to listing as were Lost River sucker, though they were occasionally caught because of the indiscriminant methods of capture. In 1985, shortnose sucker comprised 3 percent of the sport fishery catch (Bienz and Ziller 1987, p. 10). Recreational or commercial harvest of any kind has been banned since 1987, but some collection does occur for scientific purposes as permitted under the Federal and State Endangered Species Acts.

6.8.4 Disease and Predation

Non-native fishes were identified as a potential threat at the time of listing through predation and/or as sources of exotic diseases/parasites, although no direct evidence was cited. Since then, controlled experiments have demonstrated that adult fathead minnows (*Pimephales promelas*) prey on sucker larvae and may decrease sucker survival rates (Markle, D. and Dunsmoor 2007, p. 573-575). Likewise, as indirect evidence, higher larval sucker survival rates were also associated with greater water depth and shoreline vegetative cover, habitat that helps larvae avoid predation (Markle and Dunsmoor 2007, p. 573-575). These data suggest that predation by abundant fathead minnows may be an important threat to larval sucker survival, and that loss of emergent wetland habitat may exacerbate this. Other predatory non-native fishes may also pose a threat to shortnose sucker; however, little quantitative information exists to indicate their influence on sucker abundance and distribution.

6.8.5 Water Quality

Most water bodies currently occupied by Lost River and shortnose suckers do not meet water quality standards for nutrients, dissolved oxygen, temperature, and pH set by the States of Oregon and California (Boyd et al. 2002, entire, Kirk et al. 2010, entire). These conditions (primarily in summer) have caused several incidents of mass adult mortality, which appears to be a consequence of inadequate amounts of dissolved oxygen. The occurrence of mass mortality of fish in Upper Klamath Lake is not new; however, the Service believes that the increased dominance of *Aphanizomenon flos-aquae* in the system may lead to increased regularity of extreme events. Although conditions are most severe in Upper Klamath Lake and Keno Reservoir, Lost River and shortnose sucker are vulnerable to water-quality-related mortality. Degraded water quality conditions may also weaken fish and increase their susceptibility to disease, parasites, and predation.

Water quality events can increase the extent to which pathogens and parasites negatively impact sucker survival. Although fish die-offs that occurred in Upper Klamath Lake in the 1990s were likely a response to hypoxia (low levels of dissolved oxygen), disease outbreaks also probably contributed to mortality during these events (Perkins, Kann et al. 2000, p. 11).

Water quality remains one of the most important threats to Lost River and shortnose sucker; however, uncertainty about the roles and strengths of many of the drivers of water quality, including wetland reduction, natural nutrient loads, non-point sources, water management and complex interactions among these many factors, also make it one of the most difficult threats to address.

6.8.6 Climate Change

Climate variability, such as fluctuations between wet and dry periods, is part of natural processes; however, climatic models suggest that much of the recent trends in climate are driven by anthropogenic causes (Barnett et al. 2008, entire). Since the 1950s, western North America generally has exhibited trends toward less snowfall, earlier snowmelt, and earlier peak spring runoff, much of which cannot be attributed to natural fluctuations (Hamlet et al. 2005, entire, Stewart et al. 2005, entire, Knowles et al. 2006, p. 4557-4558). Furthermore, models indicate that these trends are likely to continue into the future (Barnett et al. 2008, entire). More specifically, a suite of climate models predicts that over the next 100 years the mean flow of the Sprague River will increase during winter months but decrease during the spawning period (Markstrom et al. 2012, entire, Risley et al. 2012, entire), a pattern which is likely to be exhibited throughout the upper Klamath Basin.

It is difficult to accurately predict how such climatic changes will affect the Lost River and shortnose sucker. These species are adapted to withstand periodic droughts, but given the current reduced state of the species, they may be negatively impacted if there is an increase in the intensity or frequency of droughts or a substantial shift in the timing of snowmelt and runoff. Likewise, detrimental changes in refugia availability or community composition may also accompany climate change.

6.8.7 New Threats

Although not mentioned at the time of listing as a threat, several species of birds prey on suckers, but the ultimate effect to the status of the species from these avian predators is currently unknown. Bald eagles have been observed perching in trees directly above Ouxy Springs, which is one of five areas where Lost River sucker spawn along the eastern shoreline of Upper Klamath Lake. In Clear Lake Reservoir, radio-tags and Passive Integrated Transponders (PIT tags) of individuals of both species have been located on islands associated with nesting colonies of American white pelican (*Pelecanus erythrorhynchus*), double-crested cormorant (*Phalacrocorax auritus*), and great blue heron (*Ardea herodias*) (Evans et al. 2016, p. 1255). Minimum annual rates of avian predation on Lost River and shortnose sucker, in Clear Lake Reservoir, were estimated by Evans et al. (2016, p. 1261) at 4.6 percent and 4.2 percent, respectively. Estimated minimum annual avian predation rates on suckers in Upper Klamath Lake were much lower than at Clear Lake on Lost River and shortnose sucker at 0.6 percent and 1.8 percent respectively (Evans et al. 2016, p. 1261). Predation on spawning adults increases mortality rates of this crucial life stage and may alter behavior during this critical period. For example, predation on adults at spawning sites may limit the amount of time spent on the spawning ground. Throughout the range of the species there are numerous species of piscivorous birds, including terns, grebes, and mergansers, that may prey on juvenile and larvae suckers.

Parasites were also not identified as a threat at the time of listing, but information suggests they could be a threat to the suckers. Anchor worm parasitism on age-0 suckers appears to be highly variable from year to year in Upper Klamath Lake (Bottcher and Burdick 2010, p. 19). From 1994- 1996, the percent of age-0 suckers parasitized by anchor worms ranged between 0 and 7 percent, but during 1997 through 2000 it increased to between 9 and 40 percent. In 2008, only 4 percent of captured juvenile suckers were infected with parasites, but this jumped to 18 percent in 2009 (Bottcher and Burdick 2010, p. 19). Parasites can lead to direct mortality, provide a route for pathogens to enter fish through the created wound, or can make fish more susceptible to predation by altering behavior (Robinson et al. 1998, entire). We currently do not have enough information to accurately assess the degree to which parasites negatively impact Lost River and shortnose sucker survival and productivity.

Additionally, of recent interest are the effects of microcystin, an algal toxin that affects the liver. In a 2007 survey, 49 percent of a sample of juvenile suckers (n = 47) collected at 11 shoreline sites exhibited potential indications of microcystin exposure (VanderKooi et al. 2010, p. 1). However, further controlled investigations suggest that the effects on Lost River sucker are not lethal (Foott et al. 2013, p. 24-25). The means by which the toxin is introduced into the body under natural conditions remains unknown. One hypothesis is that the toxin is indirectly ingested when suckers consume midge larvae (*Chironomidae*), which feed on the algae.

6.9 RECOVERY CRITERIA AND CONSERVATION NEEDS

The 2013 revised recovery plan for the Lost River and shortnose sucker (USFWS 2013, p. 43) describes recovery objectives for the Lost River and shortnose sucker:

Threat-based Objectives

i. Restore or enhance spawning and nursery habitat in Upper Klamath Lake and Clear Lake Reservoir systems.

ii. Reduce negative impacts of poor water quality

iii. Clarify and reduce the effects of non-native organisms on all life stages

iv. Reduce the loss of individuals to entrainment

v. Establish a redundancy and resiliency enhancement program

Demographic-based Objectives

i. Maintain or increase larval production

ii. Increase juvenile survival and recruitment to spawning populations

iii. Protect existing and increase the number of recurring, successful spawning populations.

6.9.1 Recovery Units

The 2013 revised recovery plan for the Lost River sucker and the shortnose sucker identifies recovery units for both of these species (USFWS 2013, p. 40-41). The Upper Klamath Lake Recovery Unit is subdivided into four management units:

(1) Upper Klamath Lake river-spawning individuals;

(2) Upper Klamath Lake spring-spawning individuals (Lost River sucker only);

(3) Keno Reservoir Unit, including the area from Link River Dam to Keno Dam; and

(4) Reservoirs along the Klamath River downstream of Keno Dam, known as the Klamath River Management Unit.

The Lost River Recovery Unit is also subdivided into four management units:

(1) Clear Lake;

(2) Tule Lake;

(3) Gerber Reservoir (shortnose sucker only); and

(4) Lost River proper (mostly shortnose sucker).

By specifying recovery units, the Service indicates that recovery cannot occur without viable populations in each recovery unit; however, this does not mean that each management unit has equivalent conservation value or is even necessary for species recovery. Viable populations are ones that are able to complete their life cycle regularly with recruitment and diverse age composition of the adult population.

In the 2013 recovery plan for the Lost River sucker and the shortnose sucker, the criteria to assess whether each species has been recovered are focused on reduction or elimination of threats, and demographic evidence that sucker populations are healthy (USFWS 2013, p. 43-47). The threats-based criteria for down- listing include: (1) restoring and enhancing habitats, including water quality; (2) reducing adverse effects from nonnative species; and (3) reducing losses from entrainment. To meet the population-based criteria for delisting each species must exhibit an increase in spawning population abundances over a sufficiently long period to indicate resilience, as well as establish spawning subpopulations within Upper Klamath Lake.

6.9.2 Conservation Needs

Based on the above assessment of threats to the Lost River and shortnose sucker, the following conservation actions are needed for the survival and recovery of the species:

1. Provide adequate quantity/quality of habitat;
2. Ensure population resiliency by increasing abundance and maintaining connectivity between them;
3. Improve species stability by increasing redundancy with numerous viable, self-sustaining populations
4. Prevent water quality fish kills by reducing pollution and restoring proper watershed and wetland functions;
5. Increase the frequency and magnitude of recruitment;
6. Reduce entrainment; and
7. Ensure appropriate genetic representation by minimizing anthropogenic disruption to natural genetic dynamics, including hybridization.

7 ENVIRONMENTAL BASELINE OF THE ACTION AREA

In this section, the Service summarizes natural factors, combined with past and ongoing federal, state, or private actions and other human activities in the action area that have led to the current status of the ecosystem. The environmental baseline analysis will help us assess how the proposed action will affect listed species. The action area is defined at 50 CFR 402.02 to mean "…all areas to be affected directly or indirectly by federal actions and not merely the immediate area involved in the action." For the purpose of this consultation, the Service recognizes the action area to include the shoreline margin, submerged and submersible lands of Upper Klamath Lake, Howard Bay (including the fill area and the area impacted by the mud wave), and OR-140, near Klamath Falls, Oregon. See Project Location and Action Area section above.

7.1 STATUS OF LOST RIVER AND SHORTNOSE SUCKER POPULATIONS IN THE ACTION AREA

The in-water construction in the action area is scheduled to occur during July 1– January 31, based on the Oregon Department of Fish and Wildlife guidelines to protect vulnerable life stages of important fish species, including migration, spawning, and rearing. Each life stage of the Lost River and shortnose sucker exhibit habitat preference related to time of year. Adult suckers generally inhabit water depths of 3.3 to 14.8 feet, except during spawning from February through

May and are found primarily in the northern portion of Upper Klamath Lake outside the action area during summer and early fall (Banish et al. 2009, p. 160, Peck 2000, p. 3). Adult sucker are therefore not likely to be present in the action area during in-water work. Larval transformation to juveniles is complete no later than mid-July; therefore, it is unlikely that larvae will be present in the action area during the in-water construction. Juvenile age-0 suckers primarily use relatively shallow (less than approximately 3.9 feet) vegetated areas, but may also begin to move into deeper, un-vegetated off-shore habitats (Bottcher and Burdick 2010, p. 12-14).

Based on capture data for juvenile suckers in Howard Bay, densities of age-0 suckers in the action area are low. According to Simon et al. (2010, p. 28-29) the mean age-0 sucker catch per unit effort (CPUE) from larval trawls in Upper Klamath Lake, in 2009 was 1.27, (the lowest recorded during 1995-2009) and the mean CPUE for Howard Bay was 0.5, for all sucker species combined. The mean CPUE for age-0 sucker in beach seine surveys in 2009 was 1.13 for Upper Klamath Lake and 0.5 for Howard Bay, for all species of sucker combined (Simon et al. 2010, p. 4 & 28-29). Larval trawl sampling was conducted April through July and beach seine surveys were conducted with some of overlap June through August. There are typically large declines (90-95%) in sucker captures in late summer (August to October) sampling (Simon et al. 2010, p. 5). These declines could be the result of high juvenile mortality, selectivity of gear, or entrainment in irrigation canals.

Age-0 juveniles utilize a variety of habitats but appear to select diverse shallow water habitats including vegetated and unvegetated areas and all substrates ((Buettner and Scoppettone 1990, p. 30, Burdick et al. 2008, p. 425 & 427, Hendrixson et al. 2007, p. 14). There are conflicting reports for habitat selection with some studies providing weak evidence for the selection of sandy, vegetated habitats (Burdick et al. 2008, p. 424, Hendrixson et al. 2007, p. 14), rocky substrates (Terwilliger et al. 2004, p. 23), and mud or sand (Buettner and Scoppettone 1990, p. 30), but none of these studies has found a strong association between juvenile sucker distribution and vegetation or substrate type. In general, more complex habitat structure (e.g., vegetation or rocky substrates) is thought to provide more cover for fish, and it often increases growth or survival (Strayer and Findlay 2010, p. 132-133). The near-shore habitat in the action area along Howard Bay is shallow (less than 4.3 feet), and the existing shoreline is comprised of roadway embankment with sparse vegetation. The lake substrate beyond the embankment consists of very soft, diatomaceous silt or clay silt substrate, with small isolated patches of submerged and emergent vegetation along the shoreline (FHWA 2018, p. 22). Due to water depths and lack of cover only a small number of juvenile sucker are likely to utilize the shoreline habitat in the action area during the Project.

In **Appendix 1** (Approach for Estimating Numbers of Lost River and shortnose sucker), we estimate the number of Lost River and shortnose suckers in the action area by extrapolating data that have been collected. Based on assumptions described therein, we estimate that 780 juvenile sucker are likely to be present in the action area.

The environmental baseline for the listed suckers is characterized by altered landscapes throughout Upper Klamath Lake including Howard Bay. The existing habitat in the Project area is largely riprap road embankment with little riparian vegetation. Regarding Lost River and shortnose sucker habitat, the Project area includes sparsely vegetated shallow water juvenile rearing habitat. The amount of suitable shoreline habitat in Howard Bay is also affected by changes in lake elevation (Burdick et al. 2015, p. 483)

7.1.1 Water Quality

The characteristics of the water in lakes and streams result from complex interactions among the geology, land use (historic and present), and climate of the region. Land use that shapes the flux of nutrients within the system can also affect water quality by increasing (grazing) or decreasing (wetlands) nutrient loads, among other impacts. Climate in the action area is characterized by warm dry summers and cold wet winters, as a result of being in the rain shadow of the Cascade Mountains. The vast majority of the action area is broadly classified as a temperate climate with warm-summers (temperate (C) with dry (s), warm (b) summers) by the Köppen-Geiger Climate Classification System (Peel et al. 2007, p. 1639) with most of the precipitation falling in the form of snow. Each water quality parameter summarized below is likely to impact the sucker species. The vast majority of the information on patterns and dynamics are specific to Upper Klamath Lake; however, similar patterns most likely exist within Howard Bay.

Upper Klamath Lake, the primary habitat for endangered Lost River and shortnose sucker, is a hypereutrophic water body that experiences poor water quality on a seasonal basis. Poor water quality in the lake is characterized by high water temperatures, low dissolved oxygen concentrations, high pH, elevated unionized ammonia concentrations, and intense blooms of the cyanobacteria *Aphanizomenon flos-aquae* (Boyd et al. 2002, entire). Most water bodies in the basin are listed by the Oregon Department of Environmental Quality (ODEQ) for those water quality parameters which exceed state limits, including: dissolved oxygen, temperate, bacteria, and chlorophyll a.

Upper Klamath Lake un-ionized ammonia concentrations have nearly always exceeded reporting limits (Burdick, S. M. et al. 2015, p. 19), especially in Howard/Wocus Bay region (Simon, David et al. 2000, entire). Un-ionized ammonia can be toxic to fish at relatively low concentrations. Upper Klamath Lake has experienced nuisance blooms of the cyanobacteria, *Aphanizomenon flos-aquae* during summer and autumn over the past several decades and can now be characterized as hypereutrophic.

Water quality is likely to be poor or even adverse at the time the project is implemented owing to high biomass of algae that will develop and expected warm temperature that will reduce oxygen levels during the summer months. Winds may exacerbate poor water quality conditions by transporting algae into shoreline areas. It is possible that some suckers may be present during the action. However, the number of suckers would likely be very low because the water quality may be poor.

7.1.1.1 Dissolved Oxygen

The amount of oxygen dissolved in water is controlled by temperature and pressure. Water holds 20-40 times less oxygen than air, and as temperature increases the capacity of water to hold oxygen in solution decreases (Graham 1990, p. 137). The waters of Upper Klamath Lake are oxygenated from the diffusion of oxygen from the atmosphere, inflows from streams and rivers, and photosynthesis from plants and cyanobacteria. Oxygen diffuses through water about 10,000 times slower than it does through air, the dynamics of inputs and uptakes can create zones of extremely low oxygen concentrations (Graham 1990, p. 137).

Oxygen concentrations in Upper Klamath Lake range annually from near 0 mg/L to greater than 10 mg/L, with notable spatial and temporal variations (Morace 2007, p. 32-39). In Upper Klamath Lake, high nutrient loading (particularly phosphorus) causes massive, widespread blooms of *Aphanizomenon flos-aquae*. As the bloom crashes, bacterial decomposition of the large quantities of organic matter consumes dissolved oxygen which often produces anoxic (0 mg/L of dissolved oxygen) conditions in at least some locations in Upper Klamath Lake. The severity of the dissolved oxygen depletion in Upper Klamath Lake varies depending on the size and timing of the bloom, wind action to mix the water column, and temperature. At times dissolved oxygen levels in Upper Klamath Lake are continuously below the Oregon Department of Environmental Quality (ODEQ) criterion of 5.5 mg/L for support of warm water aquatic life for weeks at a time during the summer (Kann, J. 2017, p. 35). Hypoxic dissolved oxygen concentrations (generally < 4 mg/L) occur most frequently in late July and August (Morace 2007, p. 12).

7.1.1.2 Nutrients (nitrogen/ammonia and phosphorous)

The Upper Klamath Basin has naturally high levels of nutrients in the volcanic soils, particularly phosphorous (Bradbury et al. 2004, p. 159). Runoff and erosion deliver phosphorus downstream to lakes, elevating them from the naturally eutrophic state to hypereutrophic. In Upper Klamath Lake, phosphorus concentrations vary seasonally and spatially but can be quite high and are believed to largely reflect influences of agricultural activity (wetland drainage and pasture irrigation), timber harvest, and water management.

High nutrient loading promotes corresponding high algae production, which in turn modifies physical and chemical water quality characteristics that can directly diminish the survival and production of fish population. The elevated levels of phosphorus in Upper Klamath Lake also contributed to shifts in the algal community, which are now dominated by the non-toxic cyanobacteria *Aphanizomenon flos-aquae*. Although nitrogen is also an important nutrient in structuring algae communities and determining algal productivity, *Aphanizomenon flos-aquae* uses atmospheric nitrogen to meet its nitrogen needs.

There are two forms of ammonia in solution: ionized and un-ionized. The latter is more toxic to fish, and the proportion of each is determined by the temperature and pH of the water. The lowest significant partial-mortality concentration of un-ionized ammonia determined for larval Lost River suckers is 0.69 mg/L at a pH of 9.5 (Lease et al. 2003, p. 496). The highest un-ionized ammonia concentrations easily exceed these concentrations at the deepest sites in Upper Klamath Lake during late July, coincident with blue-green algae bloom decline and low dissolved oxygen levels.

The disassociation of wetlands from the lake has meant a substantial loss of nutrient uptake capacity (Bradbury et al. 2004, p. 156). Wetlands can be both sinks and sources of nutrients depending on the time of year. During winter and spring, wetlands are major sources of nitrogen and phosphorous due to wetland plant senescence and decomposition. During the summer growing season, wetland vegetation will assimilate nutrients into plant structure. The timing of nutrient release and uptake is an important factor driving the lake's water quality dynamics.

7.1.1.3 Algal Production

Upper Klamath Lake is a hypereutrophic lake with large amounts of nutrient input, algal production increases and algal biomass accumulates until factor change to limit further growth such as, nutrients or light. Upper Klamath Lake currently experiences enormous algal blooms annually from June to October (Kann, Jacob 1997, p. 5). The complex timing and magnitude of the blooms vary among years and spatially; thus, it is difficult to link these dynamics to physical factors (Morace 2007, entire).

The massive blooms of cyanobacteria and the subsequent rapid decline (crash) can cause extremes in water quality including elevated pH, low dissolved oxygen concentration (hypoxia), and elevated levels of un-ionized ammonia. During times of high algal productivity, water pH is usually between 9.0 and 10.0 during the daytime because the cyanobacteria are photosynthesizing, which consumes dissolved carbon dioxide from the water (Kann 2017, p. 8). The photosynthesis process reduces the dissolved acid concentrations and increases the pH (making more basic) of the water. Elevation of pH values that occur in Upper Klamath Lake in excess of 10 for sustained periods can significantly impact survival of larval and juvenile suckers.

7.1.1.4 Temperature

Temperature plays a major role in water quality by directly causing stress to fish, as well as exacerbating other processes affecting water quality. Water temperature within Upper Klamath Lake annually exceeds 25 degrees Celsius during the summer months, typically reaching a maximum in late July to early August. High water temperatures can be stressful and at times lethal to fishes.

7.1.1.5 Sedimentation

Sediment core studies indicate a substantial increase in sediment accumulation rates and nutrient concentrations over the last 150 years corresponding with increases in erosion input from watersheds (Bradbury et al. 2004, p. 163-164). Sediment accumulation rates have increased from about 20 grams per square meter per year (g/m^2/year) in 1880 to a high of 120 g/m^2/year in 1995 (Eilers et al. 2001, p. 14-15). The changes in sediment composition are consistent with land use activities that occurred during this period, including substantial deforestation, drainage of wetlands, and agricultural activities associated with livestock and irrigation.

Sediment loads are also an important factor in the loading dynamics of total phosphorous in the Upper Klamath Basin. Because of the volcanic inputs, the soils of the basin tend to be high in phosphorous, which is the primary nutrient that drives much of the primary productivity and subsequent water quality. Dissolved phosphorous reacts with fine-grain sediments, particularly clays when in water; these sediments act as transport mechanisms of phosphorous from a watershed to its terminus, in this case, Upper Klamath Lake (Schenk et al. 2016, p. 27-28). During November 2013 - September 2014, the Williamson and Sprague Rivers contributed a combined 4,360 metric tons of suspended sediment to Upper Klamath Lake (Schenk et al. 2016, p. 27-28).

7.1.2 Consulted on Effects

Here we describe the effects of the past and ongoing action known to occur within the action area and which affected or are affecting Lost River and shortnose sucker. The Service reviewed these past and ongoing consultations and provides summaries of those that are most relevant in describing the environmental baseline for the subject action. In essence, those actions that resulted in discountable or insignificant effects are not included as part of this discussion, as those actions did not rise to the level of take. This does not mean that we did not consider the other actions as part of the environmental baseline, rather we opted to focus our written summary on those with higher potential to significantly affect the environmental baseline for Lost River and shortnose sucker.

7.1.2.1 Klamath Project

The Bureau of Reclamation manages several reservoirs in the upper Klamath Basin to provide water for the 250,000-acre Klamath Project, which was established in 1905 as the second federal water management project in the nation. The Bureau of Reclamation consulted with the Service multiple times on the Klamath Project since 1991 and is currently consulting on a new proposed action. As this is an ongoing action for water management in the Klamath Basin, the potential for effects from water management activities and its associated infrastructure to listed suckers is not entirely different between past and current consultations. In general, the effects to suckers have included entrainment, alteration of habitat, and water quality. The Service has authorized lethal and non-lethal take for all life stages of Lost River and shortnose sucker as a result of past and ongoing activities associated with the Klamath Project.

The creation of physical structures that are part of the Klamath Project (e.g., dams, canals, diversion points, etc.) altered the nature of the habitat both upstream and downstream. For example, habitat below Clear Lake Dam no longer functions as a migration corridor for spawning individuals because of impassable barriers, and does not provide optimal habitat for out-migrating larvae given the unnatural flow patterns through the system. Conversely, the habitat above the dam has changed from a system with a large vegetated wetland associated with open water prior to the dam to a nearly homogenous open-water system with few emergent plants in most years.

A number of conservation actions have been undertaken as part of Reclamation’s project operations such as screening of irrigation diversions, installation of a fish ladder at Link River Dam, and assisted rearing of Lost River and shortnose sucker. These actions and their effects are described below in the Conservation Efforts section.

7.1.2.2 Scientific Research

In 2018, the Service consulted (08EKLA00-2018-F-0065) on the effects to Lost River and shortnose sucker of issuing scientific permits for the purpose of promoting recovery of the species under section 10(a)(1)(A) of the ESA. The consultation addressed purposeful take of the species using a variety of scientific collection techniques, marking, transport and relocation, and biological sampling. The Service considered the effects of the issuance of scientific permits (as currently proposed) on the reproduction, abundance, and distribution of the species, as well as how the aggregation of these effects will affect the overall survival and recovery of the species.

The Service determined that the action was not likely to jeopardize the continued existence of the Lost River and shortnose sucker, nor adversely modify the designated critical habitat of the species.

7.1.2.3 Klamath Tribes Sucker Rearing

Included in the programmatic consultation on the issuance of recovery permits for actions involving Lost River and shortnose sucker (08EKLA00-2018-F-0065) is assisted rearing, which allows for the collection of up to 75,000 wild-hatched larvae from the Upper Klamath Lake system. The Klamath Tribes established a rearing program in 2018, and the first collections under the program were performed in spring 2018. A total of 20,000 larvae from the Upper Klamath Lake system were brought into captivity. This first cohort is currently in captivity with an anticipated release date in spring 2020. The current permit allows for collection of up to 20,000 larvae per year. Although the scale of releases and the specific of effects of this action are unknown at present, it is expected to result in a net positive effect through additional recruitment to populations of Lost River and shortnose sucker in Upper Klamath Lake.

8 EFFECTS OF THE PROPOSED ACTION TO THE SPECIES

The implementing regulations for section 7 define “effects of the action” as “the direct and indirect effects of an action on the species together with the effects of other activities that are interrelated or interdependent with that action, which will be added to the environmental baseline” (USFWS and NMFS 1998, p. 4-26). Direct effects are the direct or immediate effects of an action on the species or its habitat (USFWS and NMFS 1998, p. 4-25). “Indirect effects” are caused by or result from the agency action, are later in time, but are still reasonably certain to occur. Indirect effects may occur outside of the immediate footprint of the project area but would occur within the action area (USFWS and NMFS 1998, p. 2-27).

In this section, the Service describes the general mechanisms by which the proposed action may impact the listed sucker species and their habitats. Constructing new embankments will directly and indirectly affect Howard Bay, which can result to impacts to fish and other aquatic organisms.

8.1 Construction Access and Staging Area

Roadway construction has the potential to degrade water quality due to increased sedimentation and potential chemical spills. All equipment and vehicles, other than track mounted vehicles will be stored at least 300 feet away from the lake when not in use. In addition, measures will be implemented to minimize the risk of increased sedimentation, and accidental spills of toxic or hazardous material from entering the lake, through the implementation of all appropriate best management practices. Due to the implementation of measures to minimize the potential for sedimentation and chemical spills, only discountable effects are expected from construction access and staging areas.

8.2 Construction of New Embankment

The proposed action is expected to result in the short-term disturbance of approximately 2 miles of Howard Bay shoreline. Approximately 9.64 acres of permanent fill will be placed in Howard Bay to widen OR-140, resulting in the construction of new embankments. The addition of fill materials into the lake will disturb sediments and increase turbidity within 50-feet of the fill area.

The resulting sedimentation in the adjacent area are expected to exceed the Oregon Department of Environmental Quality turbidity limits.

The number of sucker potentially affected within the immediate action area is difficult to quantify, however, the number is expected to be low. Based on Project timing, only juvenile suckers would be subject to effects during the installation of the new embankment. Small numbers of juvenile suckers could be present in the action area during construction activities (July 1– January 31) because they are known to use nearby habitats. However, adults generally prefer deeper more open water during the in-water work time frame and would likely avoid the area of disturbance (Simon et al. 2010, entire). Suckers could also be absent from the action area prior to disturbance if water quality at the time of construction limits the suitability of the area. This possibility is unlikely to occur throughout the entire in-water work period but is likely to occur during the beginning of the in-water work construction period (July – August) because air and water temperature are usually at their yearly maximum and the annual algal bloom crash typically occurs in late summer. For the purpose of this effects analysis, we assume that water quality will be poor, but will not be so bad as to completely exclude suckers from the action area during construction. Juvenile suckers present in the action area are also likely to avoid the area of disturbance due to noise and activity unless trapped in the turbidity curtained area.

During construction the immediate in-water work area will be sectioned off from the rest of the bay with a turbidity curtain, to minimize and contain the short-term sedimentation resulting from construction. A chain or weight is sewn into the bottom of the curtain to anchor it to the lake bed to prevent turbid water from spreading beyond the containment area. The turbidity curtain will be installed by dragging it out into the lake from the shoreline to minimize fish entrainment. The disturbance from this installation method is expected to trigger avoidance behavior in fish present in the action area causing them to swim away from the disturbance. After installation the curtain will remain in place until the work is completed and the sediment has settled out. Therefore, any fish trapped within the curtained area will be unable to avoid further construction impacts. Juvenile Lost River and shortnose sucker could suffer direct injury or mortality from crushing during placement of rock and large woody material. Lost River and shortnose sucker juveniles may also become injured and stressed from exposure to construction-related disturbance and suspended sediments.

In summary, the construction of new embankments could disturb, injure, or kill Lost River and shortnose sucker as fill is placed in the bay and poor water quality conditions from fill-generated sediment. These adverse effects are likely to be minimized due to avoidance behavior of fish (e.g., fish will generally avoid areas of disturbance), habitat preference and the lack of suitable habitat in the area, timing of life stages occurrence, and construction BMPs.

8.3 Dredging

To ensure the functionality of the county boat ramp, lake-bottom material deposited during construction activities may need to be removed during the in-water work period. Dredging activities will be cordoned off by a turbidity curtain to contain sediment laden waters within the work area. As this activity will be completed in conjunction with the construction of new embankments, the effects of dredging will result in a negligible increase to the overall mobilization of sediments. To prevent sediment from re-entering waterways, the removed materials will be taken to an upland area away from the lake for disposal. Due to the implementation of measures to minimize the potential for sedimentation mobilization and transport, only discountable effects are expected from dredging to clear the boat ramp.

8.4 Upland Roadway Construction

Approximately 4 miles of upland roadway construction will be completed from mile post 59.0 to mile post 62.6 where OR-140 intersects with Lakeshore drive. Construction of the new wider roadway will be completed by clearing and grubbing along the right-of-way and grading cut and fill slopes. Because this section of roadway is located away from Upper Klamath Lake, only insignificant effects are expected from upland roadway construction.

8.5 Stormwater Treatment features (Drainage)

The FHWA proposes to include construction BMPs, permanent stormwater runoff treatment features such as, biofiltration swales, vegetated filter strips, ditch relief culverts, riprap, and seeding as part of the OR-140 highway construction. These stormwater features slow the movement of water while, increasing water infiltration and filtration, resulting in the reduction of pollutants entering Upper Klamath Lake.

In the long-term, the addition of stormwater treatment features along the roadway may have beneficial effects to Lost River and shortnose sucker by reducing the transport of sediments and pollutants from impervious surfaces to Upper Klamath Lake; these features, have the potential to improve the lake's water quality. Due to the implementation of measures to minimize the potential for sedimentation and pollution during construction of stormwater features, only discountable effects are expected from this element of the action.

8.6 Maintenance

The additional roadway width resulting from completion of the Project will not require changes to ODOT maintenance activities and will, therefore, have insignificant effects on the Lost River and shortnose suckers.

8.7 Mitigation Site

The proposed Mill site mitigation property construction will take place in 2020 and will coincide with the construction of the new embankment along Howard Bay. The entire 45-acre Mill site will be graded prior to the construction of the 10.09 acre mitigation which, shall result in the establishment of 0.45 acres of emergent and scrub-shrub wetlands and 9.64 acres of open water and emergent wetlands.

In the long-term, the construction of the wetland mitigation site has the potential to result in minor improvements to water quality, due to the role of wetlands as a filtering system, removing sediment, nutrients and pollutants from the water. By slowing down water currents and decreasing wave action, wetlands act as sediment traps and temporary storage for water where wetland plants can help to immobilize nutrients through uptake and subsequent burial in the soil (Bradbury et al. 2004, p. 156). Marsh peats and organic soils typically act as sinks for nutrients and organic matter under natural conditions because decomposition is slower in anoxic soils than decomposition of new material (Snyder and Morace 1997, p. 44).

Construction activities will result in temporary disruption of normal Lost River and shortnose sucker behaviors (including foraging and sheltering) from exposure to turbidity plumes, breaching dikes by blasting or excavation, and mechanical excavation of deeper channels and of high land areas. Dike breaching will occur during the in-water work time frame, during periods of low lake elevation, so that earthworks (e.g. grading, excavating, and blasting) can take place on dry soil to the greatest extent possible. Completing earthworks, to the greatest extent possible, prior to breaching the dikes along the lake will reduce sedimentation into the lake and reduce the risk of injury to the listed suckers. Juvenile suckers present in the action area are also likely to flee or avoid the area of disturbance due to noise and activity. The main effect resulting from construction of wetlands is from increased lake turbidity and sedimentation in in the action area. Neither of these effects should result in lethal harm to Lost River and shortnose sucker.

These temporary exposures may cause suckers to avoid this portion of the action area, may discourage free movement through this portion of the action area, and expose individuals to less favorable conditions in the short-term. However, the effects of disturbance will be temporary, and only insignificant effects to suckers are expected from the construction of the mitigation site wetlands.

8.8 Summary of Project Effects

These Project activities will result in the following effects to the Lost River and shortnose sucker and their critical habitat. Some of these effects will be temporary, construction related, and limited in both physical extent and duration. Others will be long-term, lasting for the functional life of the proposed action:

- Direct injury/mortality of juvenile Lost River and shortnose sucker from crushing during placement of rock and large woody material.
- Direct short-term effects (i.e., stress and/or injury) resulting from exposure to construction-related disturbance, turbidity and suspended sediments.
- Indirect effects to Lost River and shortnose sucker from impacts of sediment deposition that leads to reduced food sources, such as macroinvertebrates.
- Long-term effects to lake habitat structure, function, and diversity.
- The Project will result in new highway embankments and the establishment of scrub-shrub wetland, emergent wetlands, and open water wetlands will alter lake margins in the affected areas. Habitat alterations have the potential to improve cover and protection for juvenile Lost River and shortnose sucker.
- The mitigation site construction has the potential to restore natural wetland habitat functions and connectivity over the long-term by slowing down water currents and decreasing wave action. Wetlands act as sediment traps and temporary storage for water where wetland plants can help to immobilize nutrients through uptake and subsequent burial in the soil.

9 CUMULATIVE EFFECTS

Section 7 regulations define cumulative effects to include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this

Opinion (50 CFR 402.02). There are no future State, tribal, or private actions reasonably certain to occur in the action area; therefore, cumulative effects are not anticipated.

10 STATUS AND ENVIRONMENTAL BASELINE OF CRITICAL HABITAT OF LOST RIVER AND SHORTNOSE SUCKER

In this section, we assess the range-wide conditions of the Lost River and shortnose sucker designated critical habitat. We describe factors relating to the condition of the physical and biological features necessary for the survival and recovery of the species. We also present the environmental baseline of the designated critical habitat, against which the effects of the proposed action will be assessed.

10.1 LEGAL STATUS

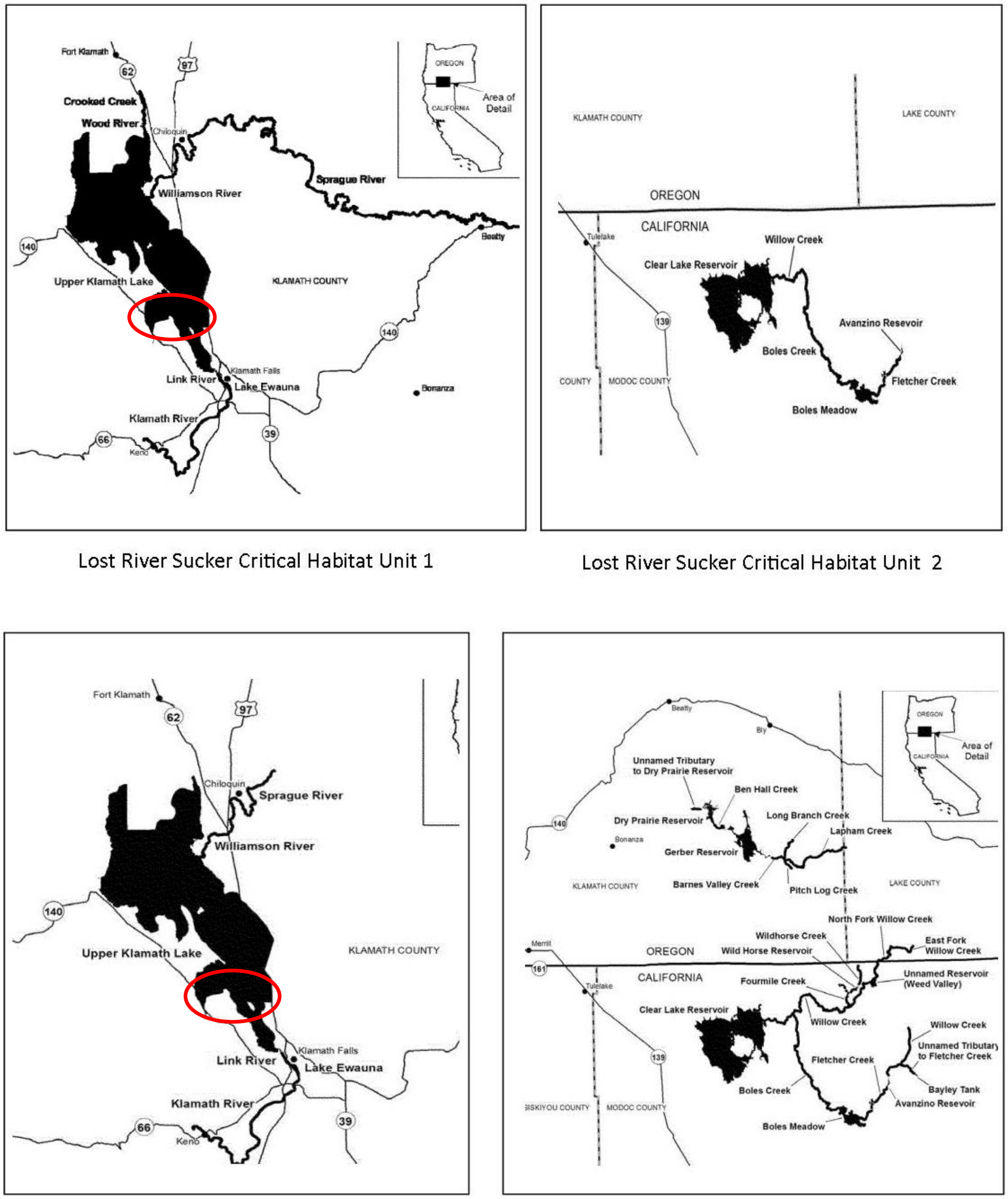
The Service proposed critical habitat for the LRS and the SNS on December 1, 1994 (USFWS 1994, p. 61744), but the proposal was not finalized. On December 7, 2011, a revised proposal was published that included critical habitat in Klamath and Lake Counties, Oregon, and Modoc County, California (USFWS 2011, p. 76337). Designation of critical habitat for the LRS and the SNS was finalized on December 11, 2012 (USFWS 2012, p. 73740).

10.2 CRITICAL HABITAT DESCRIPTION

On December 11, 2012, the U.S. Fish and Wildlife Service published a final rule designating critical habitat for the Lost River and shortnose sucker (USFWS 2012, entire) . The designation included two Critical Habitat Units (CHU) for each species and the units include a mix of federal, state, and private lands. The Upper Klamath Lake Critical Habitat Unit 1, situated in Klamath County, Oregon, includes Upper Klamath Lake and Agency Lake, the Link River and upper Klamath River downstream to Keno Dam, as well as portions of the Williamson and Sprague Rivers, for a total of approximately 90,000 acres (36,422 hectares) and 120 river miles. This critical habitat unit is the same for both species with the exception that, for the Lost River sucker, the unit extends up the Sprague River to the Beatty Gap east of Beatty (near river mile 75), whereas for the shortnose sucker, it only extends up the Sprague River as far as Braymill near river mile 8.

Lost River Basin Critical Habitat Unit 2 is situated in Klamath and Lake Counties Oregon, and Modoc County California. It includes Clear Lake and its main tributary, Willow Creek, for both the Lost River and shortnose sucker, and Gerber Reservoir and its main tributaries for the shortnose sucker only, for a total of approximately 33,000 acres (13,355 hectares) and 88 river miles. Additionally, there are differences in the amount of upstream critical habitat in Willow Creek for the two species. For the Lost River sucker, critical habitat includes Willow Creek and its tributary, Boles Creek, upstream to Avanzino Reservoir in California. For the shortnose sucker, critical habitat extends up Willow Creek to Boles Creek and upstream past Fletcher Creek, and includes Willow, Fourmile, and Wildhorse Creeks in California, and Willow Creek to its East Fork in Oregon.

Designated critical habitat for the Lost River and shortnose sucker in the Project area is only within CHU 1 (Figure 4), and the portion of the Project that is in CHU 1 is confined to the western edge of Howard Bay along OR-140 and the Mill wetland mitigation site in the Upper Klamath Lake across from Howard Bay.



Lost River Sucker Critical Habitat Unit 1

Lost River Sucker Critical Habitat Unit 2

Shortnose Sucker Critical Habitat Unit 1

Shortnose Sucker Critical Habitat Unit 2

Figure 4. Designated CHUs for Lost River and shortnose sucker; red circle denotes action area (Howard Bay and wetland mitigation site) (USFWS 2012, entire) .

10.2.1 Conservation Role of Critical Habitat

Critical habitat contains those areas that are essential to the conservation of the species. The role of Lost River and shortnose sucker critical habitat is to "support the life-history needs of the species and provide for the conservation of the species" (USFWS 2012, p. 73756).

10.2.2 Physical and Biological Features

In accordance with sections 3(5)(A)(i) and 4(b)(1)(A) of the Act and regulations at 50 CFR 424.12, in determining which areas within the geological area occupied by the species at the time of listing to designate critical habitat, we considered the physical and biological features essential to the conservation of the species which may require special management considerations or protection.

The following physical and biological features were considered essential to the conservation of each sucker species and may require special management considerations or protection:

1. Space for individual and population management considerations or protection;
2. Food, water, air, light, minerals, or other nutritional or physiological requirements;
3. Cover or shelter;
4. Sites for breeding, reproduction, or rearing (or development) of offspring; and
5. Habitats that are protected from disturbance or are representative of the historical, geographical, and ecological distribution of a species.

Note: Past designations of critical habitat have used the terms “primary constituent elements” (PCEs), PBFs, or “essential features” to characterize the key components of critical habitat that provide for the conservation of the listed species. The new critical habitat regulations (USFWS 2016, p. 7214) discontinue use of the terms “PCEs” or “essential features” and rely exclusively on use of the term PBFs for that purpose because that term is contained in the statute. To be consistent with that shift in terminology and in recognition that the terms PBFs, PCEs, and essential habit features are synonymous in meaning, we are only referring to PBFs herein. Therefore, if a past critical habitat designation defined essential habitat features or PCEs, they will be referred to as PBFs in this document. This does not change the approach outlined above for conducting the “destruction or adverse modification” analysis, which is the same regardless of whether the original designation identified PCEs, PBFs or essential features.

The physical and biological features (PBFs) of critical habitat are the specific elements of physical and biological features essential to the conservation of the species. Based on our current knowledge of the habitat characteristics required to sustain the species’ life history processes, the PBFs specific to self-sustaining Lost River and shortnose populations are:

- PBF 1—Water. Areas with sufficient water quantity and depth within lakes, reservoirs, streams, marshes, springs, groundwater sources, and refugial habitats with minimal physical, biological, or chemical impediments to connectivity. Water must have varied depths to accommodate each life stage: Shallow water (up to 3.28 ft [1.0 m]) for larval life stage and deeper water (up to 14.8 ft [4.5 m]) for older life stages. The water quality characteristics should include water temperatures of less than 28.0 °Celsius (82.4 °F); pH less than 9.75; dissolved oxygen levels greater than 4.0 mg per L; low levels of microcystin; and un-ionized ammonia (less than 0.5 mg per L). Elements also include natural flow regimes that provide flows during the appropriate time of year or, if flows are controlled, minimal flow departure from a natural hydrograph.

- PBF 2—Spawning and Rearing Habitat. Streams and shoreline springs with gravel and cobble substrate at depths typically less than 4.3 ft (1.3 m) with adequate stream velocity to allow spawning to occur. Areas containing emergent vegetation adjacent to open water provides habitat for rearing and facilitates growth and survival of suckers, as well as protection from predation and protection from currents and turbulence.
- PBF 3—Food. Areas that contain abundant forage base, including a broad array of *chironomidae*, *crustacea*, and other aquatic macroinvertebrates.

Specific habitat-based threats identified in the critical habitat designation that may require special management considerations include (1) poor water quality; (2) potential entrainment at water diversion structures; (3) lack of access to essential spawning habitat; (4) lack of connectivity to historical habitat (i.e., migratory impediments); (5) degradation of spawning, rearing, and adult habitat; and (6) avian predation and predation by or competition with nonnative fish (p. 73750). These are discussed in detail in the final critical habitat rule (77 FR 73740).

Special management considerations for designated critical habitat include the following:

- Protect and improve water quality by reducing sediment and nutrient loading
- Manage water bodies so that there is minimal departure from a natural hydrograph
- Maintain, improve, or reestablish instream flows to improve the quantity of water available
- Manage groundwater use to ensure it does not affect surface waters
- Address water level fluctuations in reservoirs
- Maintain appropriate depths in and buffers around water quality refuge areas for fish access
- Maintain habitat in reservoirs; the timing and volume of water diverted needs to be considered
- Improve access to spawning and rearing habitats
- Manage exotic fishes by restoring habitats for native fishes

10.3 ENVIRONMETNAL BASELINE OF LOST RIVER AND SHORTNOSE SUCKER CRITICAL HABITAT

The proposed action area lies within Upper Klamath Lake CHU 1. The Project will modify and disturb approximately 9.64 acres of the 90,000 acres designated within CHU1. The Project area is largely riprap road embankment that includes sparsely vegetated shallow water juvenile rearing habitat.

Water quantity, water quality, and physical habitat for spawning, feeding, rearing, and travel corridors are generally poor in this portion of the CHU at the time of year when construction is proposed. Reduced water quality and low dissolved oxygen, both in summer and winter below ice cover, are likely to occur. The near-shore habitat along that portion of the action area open to Upper Klamath Lake is shallow (less than 4.3 feet), were the existing shoreline is comprised of roadway embankment with sparse vegetation. The lake bottom beyond the embankment consists of very soft, diatomaceous silt or clay silt substrate (FHWA 2018, p. 22). There are small isolated patches of submerged and emergent vegetation along the shoreline (see section 7.0 Environmental Baseline of action area for detailed description).

10.3.1 Consulted on Effects to Designated Critical Habitat

Consultations on effects to designated critical habitat are discussed in section 7.1.3. Specifically, consultations regarding water management on the Klamath Project (7.1.3.1) and issuance of scientific permits (7.1.3.3) are directly relevant. No actions since the final designation of critical habitat have been determined to constitute adverse modification of critical habitat.

11 EFFECTS OF THE PROPOSED ACTION ON CRITICAL HABITAT

At issue for this biological opinion are effects of the proposed Project on three PBFs (1) water; (2) spawning and rearing habitat; and (3) food. Sucker critical habitat must provide adequate water quality and quantity; adequate spawning habitat for adult sucker; adequate rearing habitat for sucker embryos, larvae, and juveniles; and adequate foraging habitat (inclusive of a diverse and abundant prey base) for all sucker life stages to support the conservation of these species. Variation in quality of PBF function can occur and still adequately support the conservation of the listed sucker species. As noted above, within the Project area the PBFs of critical habitat are generally poor for the listed sucker species within the CHU, at the time of year when construction is proposed.

11.1 PBF 1: WATER

Short-term and spatially limited adverse water quality impacts are expected to result from the addition of fill and from the construction of the mitigation site. Sedimentation is expected to be the primary effect on water quality, as substrate sediments begin to push up into the water column. Although sedimentation is expected to occur it will be isolated to the in-water work areas by a turbidity curtain, to prevent it spreading throughout the rest of the lake, allowing sediment to settle out. The Project includes minimizing the potential introduction of toxic or hazardous material to critical habitat by restricting temporary extra workspace (staging area) outside of the critical habitat zone, mandating storage of hazardous materials in controlled and remote areas (300 feet away from water bodies). Riparian vegetation, vegetation filter strips, and aquatic plants will be planted to reduce the movement of stormwater while, increasing water infiltration and filtration, resulting in the reduction of pollutants entering Upper Klamath Lake.

In the short-term, water quality is expected to be reduced as part of the in-water work portion of the Project, but within tightly contained areas. In the long-term, upon completion of wetland mitigation efforts at the Mill site, water quality has the potential to show improvement from wetland re-establishment and connectivity to the lake as wetlands act as filtering system that removes sediment, nutrients, and pollutants from the water (Bradbury et al. 2004, p. 156). Therefore, the effects to water quality from this action are discountable.

11.2 PBF 2: SPAWNING AND REARING HABITAT

Project embankment construction will result in 9.64-acres (along approximately 9,715 linear feet of shoreline) of rearing habitat, directly adjacent to OR-140, being turned into roadway and new embankment changing shoreline features and geomorphology. This shallow water area provides habitat for larval and juvenile sucker rearing, feeding, and refugia from predation (FHWA 2018, p. 34). The designated wetland mitigation site is not currently usable habitat for sucker rearing but will be after the completion of the proposed action. Additionally, no spawning sites are located in the action area; therefore, the proposed action will have no effect on sucker spawning habitat.

In the long-term, the Project has the potential to improve rearing habitats from the proposed conservation measures, design features of the new embankments, and construction of the wetland mitigation site. The new embankment construction design will include cover and protection habitat enhancements for rearing juvenile sucker such as, an increased irregular shoreline (an addition of 60 linear feet), rock points, larger boulders in the base fill, large woody material, and planting of bulrush and bur-reed. Additionally, the mitigation Mill site will create new shallow water habitat that could potentially be used for sucker rearing in the future.

The proposed Project includes the modification of 9.64 acres of rearing critical habitat in Howard Bay and the creation of 10.09 acres of open water habitat and emergent wetlands at the mitigation site. Negative effects to the critical habitat are likely to be localized to the area within the Project footprint (cumulatively, 19.73 acres) in Upper Klamath Lake and limited to the period of active construction. It is anticipated that following completion of the in-water work designated critical habitat condition will return to baseline or be improved as a result of the installation of the new embankment and mitigation site. The implementation of conservation measures will minimize the effects, however, the effects to critical habitat are adverse due to the loss of 9.64 acres of rearing critical habitat. The area affected is small (less than 1 percent) relative to the total area of Upper Klamath Lake.

11.3 PBF 3: Food

The addition of fill material into the lake and the construction activities is likely to impact food availability along the shoreline of OR-140 adjacent to Howard Bay. The habitat disturbance and modification will temporarily decrease vegetation, zooplankton, and macroinvertebrate populations in the action area. However, the Service believes this is not a limiting factor of habitat suitability in Upper Klamath Lake. Upper Klamath Lake and its tributaries are highly productive and contain dense populations of zooplankton and macroinvertebrates (Stauffer-Olsen et al. 2017, p. 263).

The proposed action will result in a short-term, localized degradation of the food base through sedimentation in the action area where production of macroinvertebrates will be reduced. However, the Project is not expected to change the overall availability of food in the CHU but might temporarily change the distribution until zooplankton and other aquatic macroinvertebrates can move in to disturbed areas. Therefore, the effects to Lost River and shortnose sucker food from this action are insignificant.

11.4 Summary of Project Effects

In the preceding section, we determined the proposed action will result in localized and temporary degradation of PBF (1) water quality; (2) rearing habitat; and (3) food availability. These effects will occur throughout the cumulative 19.73 acres of habitat and the duration of the effects will be limited to the construction period.

Although we anticipate localized adverse effects to designated critical habitat from implementation of the proposed action, these effects are not anticipated to appreciably reduce the likelihood of persistence through a reduction in the numbers, distribution, or reproduction of Lost River and shortnose sucker in the affected areas or within the listed species range. Additionally, the proposed action will not permanently reduce the function of the designated critical habitat in the action area to provide for the conservation of the species. Considering the localized nature of the effects of the proposed action, we conclude that the proposed action does not diminish the overall conservation role of the critical habitat.

12 CUMULATIVE EFFECTS TO CRITICAL HABITAT

Section 7 regulations define cumulative effects to include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Opinion (50 CFR 402.02). There are no future State, tribal, or private actions reasonably certain to occur in the action area. Therefore, cumulative effects to PBFs from implementation of the proposed action are not expected to be additive to any foreseeable project in the action area.

13 CONCLUSION

After reviewing the current status of Lost River and shortnose sucker, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the Federal Highway Administration's widening of OR-140, discussed herein, is not likely to jeopardize the continued existence of the Lost River and shortnose sucker or adversely modify their critical habitat. The Service reached this conclusion based on the factors analyzed above and summarized below.

13.1 LOST RIVER SUCKER AND SHORTNOSE SUCKER JEOPARDY DETERMINATION

In Section 6 (*Status of the Lost River and Shortnose Sucker*), we described the factors that have led to the current status of the Lost River and shortnose sucker as endangered throughout their range under the Endangered Species Act. The threats to the listed suckers are habitat loss, disease and predation, water quality, entrainment, and climate change. The 2013 recovery plan identifies a number of recovery actions to address these threats. Federal and non-Federal contributions to sucker recovery include improvements to habitat connectivity, multi-partner habitat restoration efforts, and implementation of sucker rearing program.

A number of natural and anthropogenic past and ongoing actions contribute to the current conditions of the action area. The action area is Howard Bay located in Upper Klamath Lake, which contains the largest remaining populations of both Lost River and shortnose sucker. However, there has not been evidence of juveniles entering into the spawning populations since the late 1990s, and the lack of recruitment has led to sharp population declines. Specific factors limiting Lost River and shortnose sucker resilience in Upper Klamath Lake include higher than natural mortality of juveniles due to degraded water quality, algal toxins, disease, parasites, predation, competition with native and introduced species, and entrainment into water management structures. Adult populations in Upper Klamath Lake are limited by negligible recruitment, stress and mortality associated with severely-impaired water quality, and the fact that adult suckers are approaching the limits of their life span. Still, recent survival rates of adult suckers in Upper Klamath Lake have been relatively high (Hewitt et al. 2018, p. 24-26), though initial data suggest that survival between spring of 2016 and 2017 was lower than usual. Additionally, these species are limited by a lack of connectivity throughout their range by dams, periodic low flows, and degraded habitat.

Because of a multi-decade lack of recruitment of Lost River and shortnose sucker in Upper Klamath Lake and their current old ages, both species will be at a high risk of extirpation without recruitment. A die-off of adult suckers in Upper Klamath Lake, similar to those that occurred in the 1990s, could be catastrophic, especially for shortnose sucker because of its low abundance. It is also possible that a low recent annual adult survival rate could portend an increase in mortality due to senescence, but additional years of data will be necessary to evaluate this hypothesis. Regardless, their continued survival in Upper Klamath Lake depends on recruitment in the near future.

In our *Environmental Baseline in the Action Area* (Section 7), we described conditions and past actions that currently affect the survival and recovery of Lost River and shortnose sucker within the action area, including: (1) negative effects of water quality (e.g., low dissolved oxygen, high pH, algal toxins, and urban and agricultural run-off) to suckers in Upper Klamath Lake; (2) native and introduced pathogens, parasites, and predators; (3) diversions of water for agriculture and drought that can reduce the access to and availability of spawning and rearing habitats, especially during droughts when water use increases.

As described in section 8, the proposed action will likely result in the lethal and nonlethal harm to Lost River and shortnose sucker but is not expected to appreciably reduce the likelihood of survival and recovery of the species in the wild. Harm may result from the potential for embankment material to crush or otherwise alter Lost River and shortnose sucker behaviors (e.g., fleeing). A total of 780 juvenile sucker may be subjected to lethal harm which is only a small portion of the listed species population in Upper Klamath Lake. Other life stages will not be harmed. Project effects will be temporary in nature, spatially and temporally restricted, and affect only a very small portion of the Lost River and shortnose sucker population.

In summary, the proposed action is not likely to result in jeopardy for the Lost River and shortnose sucker. The Service reached this conclusion based on the following finding, the basis for which is presented in the preceding *Status of the Lost River and Shortnose Sucker* (section 6), *Environmental Baseline in the Action Area* (section 7), *Effects of the Action* (section 8), and *Cumulative Effects* (section 9) of this Biological Opinion. The status of the species suggests that threats are still acting on the species; however, conservation partnerships, improvements to habitat connectivity, and captive rearing programs are working towards improving the status of the species. The Service recognizes it may be many years before the outcomes of these efforts are realized. The environmental baseline in the action area is degraded by natural and anthropogenic past and ongoing activities. The proposed action will harm juvenile Lost River and shortnose sucker; as indicated above, the overall effect at the range-wide scale is very small (less than 1%). The number of listed suckers potentially impacted is likely over estimated due to the need to adopt a worst-case scenario analysis so we can be protective of the species.

Additionally, using recent history as a guide, the individual juvenile fish that may be harmed by this action would not successfully recruit into the adult population due to a combination of threats faced by the species; therefore, the small amount of individuals harmed at this life stage are currently not likely to reach the adult life stage, so this harm is not anticipated to further imperil the species. A maximum of 780 juvenile suckers may be harmed from the proposed action; however, the number of individuals affected will likely be much lower due to the use of the turbidity curtain and how it will be deployed. Therefore, while there are adverse impacts to Lost River and shortnose sucker, implementation of the proposed action is not expected to appreciably reduce the survival and recovery of the species in the wild.

13.2 Destruction or Adverse Modification of Critical Habitat

In accordance with policy and regulation, the destruction and adverse modification analysis in this biological opinion relies on four components: (1) the status of critical habitat range-wide in terms of physical or biological features (PBFs); (2) the environmental baseline of the critical habitat in the action area; (3) the effects of the proposed action on the PBFs and how that will influence the recovery role of affected critical habitat units; and (4) cumulative effects of future activities in the action area on PBFs and how that will influence the recovery role of the critical habitat units.

After reviewing the effects of the proposed action on the designated critical habitat in the action area, it is the Service's determination that the implementation of the FHWA's action as proposed is not likely to adversely modify designated critical habitat for Lost River and shortnose sucker. The Service reached this conclusion based on the factors analyzed above, which are summarized below.

In section 10.2 *Critical Habitat Description*, we discussed the range-wide condition of designated critical habitat for the Lost River and shortnose sucker in terms of PBFs, factors responsible for the condition and the intended recovery function of critical habitat overall. Water quantity, water quality, and physical habitat for spawning, feeding, rearing, and travel corridors are generally poor in this portion of the CHU.

PBF 1 is water quantity and quality. The two critical habitat units have a similar status with respect to water quantity. Namely, water quantity across days, seasons, and years, and low lake elevations or streamflow can reduce the recovery support function of the critical habitat by reducing availability of and access to suitable habitat. The water quality is highly degraded in CHU 1.

PBF 2 is spawning and rearing habitat. Spawning habitat is largely functioning as intended in both critical habitat units. Some of the habitat at the Upper Klamath Lake shoreline springs in CHU 1 occasionally becomes unusable due to low lake elevations. Rearing habitat has been greatly reduced from historical levels in CHU 1 through the draining of wetlands. Thousands of acres of emergent wetlands still exist, but these can become largely unavailable at very low lake elevations.

PBF 3 is food. Although food availability has not been specifically evaluated across all of the critical habitat, the upper Klamath basin is highly productive, and all of the critical habitat appears to contain an abundant forage base.

Overall, the habitat of the species has been degraded in numerous ways that are likely to reduce the capacity of the habitat to support the life history and provide for the conservation of Lost River and shortnose sucker. In Critical Habitat Unit 1, the environmental baseline of poor water quality is of particular note because it creates stressful conditions for juvenile and adult suckers annually in late summer.

The *Effects of the Proposed Action on Critical Habitat* (section 11) of this biological opinion described how the proposed action is likely to affect PBFs 1, 2, and 3, as well as recovery-support functions for Lost River and shortnose sucker in CHU 1 Upper Klamath Lake. The area affected is small (less than 1 percent) relative to the total area of designated critical habitat. Furthermore, the adverse effects to water quality that are attributed to FHWA construction activities are likely small and temporary and occur when water quality is already poor for other reasons. Upon completion the proposed action has the potential to improve cover and protection habitat for the juvenile listed sucker species. Restoration of the natural wetland at the Mill mitigation site has the potential to result in minor improvements to habitat function, connectivity, and water quality over the long-term, by slowing down water currents and decreasing wave action.

In summary, based on the information provided in this analysis, the proposed action is not likely to significantly affect the recovery-support function of designated critical habitat for Lost River and shortnose sucker. While the proposed action will result in the loss of 9.64 acres critical habitat, it will not alter the essential physical or biological features to an extent that it appreciably reduces the conservation value of critical habitat range-wide for the Lost River and shortnose sucker. Additionally, the Project has the potential to enhance rearing habitat with the embankment enhancements and the restoration to the Mill wetland mitigation site. Therefore, the Service does not anticipate that effects of the proposed action, taking into account cumulative effects, will result in the destruction or adverse modification of Lost River and shortnose sucker critical habitat.

14 INCIDENTAL TAKE STATEMENT

Section 9 of the Act, and Federal regulations pursuant to Section 4(d) of the Act, prohibit the take of endangered and threatened species, respectively without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the FHWA so that they become binding conditions of any grant or permit issued to the permittees, as appropriate, for the exemption in section 7(o)(2) to apply. The FHWA has a continuing duty to regulate the activity covered by the incidental take statement. If the FHWA (1) fails to assume and implement the terms and conditions or (2) fails to require the permittees to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective converge of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FHWA must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i) (3)].

14.1 Amount or Extent of Take Anticipated

In the accompanying opinion, the Service determined that the proposed action will result in take of juvenile Lost River and shortnose sucker in the form of disturbance and harm. The incidental take is expected to be lethal and nonlethal and result from embankment material crushing juveniles and fleeing behavior of juveniles from construction activities (turbidity curtain installation, addition of fill, and negative water quality impacts). While fleeing from the turbidity curtain installation can cause stress to the listed suckers, it is likely to reduce lethal harm relative to individuals trapped in the fill area. Based on the life history of the suckers and timing and location of construction the Service anticipates that no eggs, larvae, or adults are expected to be taken (see sections 6.5 – 6.8 habitats for each life stage).

The amount of incidental take of listed juvenile suckers described below is based on limited data and numerous assumptions, and nearly all forms of take will be impracticable to detect and measure for the following reasons: (1) to identify juvenile listed suckers to species requires collecting, transporting to a lab, and x-raying the suckers to count the number of vertebrae; (2) precise quantification of the number of listed suckers entrained in the Project area would require nearly continuous monitoring and would itself result in considerable lethal take; (3) the likelihood of finding injured or dead suckers in a relatively large area is very low; (4) a high rate of removal of injured or killed individuals by predators or scavengers is likely to occur, which also makes detection difficult. Furthermore, poor lake water quality is likely in Howard Bay during the in-water work time frame causing suckers to leave the area resulting in a relatively small number of suckers present. Area of habitat impacted provides a measurable element that is a suitable surrogate for take. Because some information on sucker densities within Howard Bay are available, we can make a gross approximation of the number of suckers potentially affected along the impacted shoreline by multiplying the estimated density of juvenile suckers in similar shoreline habitats by the area impacted.

In **Appendix 1**, we estimate the number of Lost River and shortnose suckers likely to be affected in the action area by extrapolating data that have been collected. Based on the best available information and the assumptions described in Appendix 1, the greatest amount of take would be a maximum of 780 juvenile suckers that are killed as a result of the proposed action.

14.2 Effects of Take

In the accompanying biological opinion, the Service determined that the level of anticipated take (9.64 acres of modified habitat or approximately 780 juvenile suckers) is not likely to jeopardize the continued existence of the Lost River and shortnose sucker. The anticipated adverse effects to the Lost River and shortnose suckers are not expected to reach a level that would affect recovery of the species because the number of suckers taken is small and is likely overestimated, due to the assumption that all suckers present in the action area will be killed.

The proposed action incorporates design elements and conservation measures (section 4.8) which we expect will minimize impacts during construction. Additionally, the construction of the wetland mitigation site discussed in section 4.7 has the potential to improve lake water quality and juvenile sucker habitat.

14.2.1 Reasonable and Prudent Measures

Reasonable and Prudent Measures are non-discretionary measures designed to minimize impacts on specific individuals or habitats affected by the proposed action, and involve only minor changes to the proposed action. Pursuant to 50 CFR 402.14 (I) (ii), reasonable and prudent measures are those the Service considers necessary to minimize the effects of the incidental taking. The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize the effect of the take on Lost River and shortnose sucker:

1. Minimize harm to Lost River and shortnose suckers from exposure to construction-related disturbance, turbidity and suspended sediments.
2. Limit excavation of submerged substrates to that necessary to excavate displaced materials from the boat ramp to maintain operation.

14.2.2 Terms and Conditions

To be exempt from the prohibitions of Section 9 of the Act, the FHWA shall ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

1. Ensure that construction related disturbances, turbidity and suspended sediments are isolated from the rest of Upper Klamath Lake with a turbidity curtain. Turbidity curtain shall not be removed until turbidity within the barrier approaches adjacent water turbidity.
2. Inspect turbidity curtain for holes prior to deployment and monitor turbidity curtain during deployment to ensure its integrity (e.g., does not lift off bottom, get holes) to prevent suckers from re-entering the area.
3. Ensure that no unnecessary actions are taken that increase entrainment of listed suckers in the isolated work site. Install the turbidity curtain by dragging it out into the lake from the shoreline. All in water work will be conducted between July 1 and January 31.
4. Turbidity curtain should remain in place during the entire period of excavation, fill, and blasting to reduce disturbance and the possibility of suckers moving back into the disturbed habitat prior to the completion of the project.
5. Ensure that excavation of submerged substrates is limited to that necessary to maintain operation of Howard Bay boat ramp.

6. Ensure that grading and excavation at the Mitigation site takes place prior to breaching the dikes to the extent feasible.

The Service anticipates that these Reasonable and Prudent Measures and their implementing terms and conditions will reduce or eliminate the amount of take analyzed and authorized in this biological opinion.

14.2.3 Monitoring Requirements under the Terms and Conditions

In order to monitor the effects of incidental take, the Federal agency or any applicant must report the progress of the action and its effects on the species to the Service. The reporting requirements are established in accordance with 50 CFR 13.45 and 18.27 and specified as follows:

The FHWA will provide annual implementation monitoring reports of the proposed action by April 1 for the term of this biological opinion (2020 construction season through 2022 construction season). Specifically, the annual report shall list and describe:

1. How much and which elements of the proposed action have been implemented to date?

2. Were there any changes to proposed action and if so, please provide the rationale for changes.

3. Has anything occurred during project implementation that would potentially change the impacts to suckers in a way that is different from those described in the FHWA biological assessment? For example, is there any new information regarding sucker distribution and use of the Project area?

4. Has anything changed during the project implementation that could have resulted in the take estimate being exceeded (see Amount or Extent of Take Anticipated section on biological opinion)?

5. Implementation of any conservation measures recommended in section 16 below.

Reports shall be submitted to the Field Supervisor, Klamath Falls Fish and Wildlife Office, 1936 California Avenue, Klamath Falls, Oregon, 97601.

15 REPORTING REQUIREMENTS

Upon locating a dead, injured, or sick endangered or threatened species specimen, prompt notification must be made to the Klamath Falls Fish and Wildlife Office at 1936 California Avenue, Klamath Falls, Oregon, 97601 or by telephone at (541) 885-8481. Notification must include the date, time, and location (including GPS location information in UTM, NAD 83) of the incident or discovery of a dead or injured shortnose sucker, as well as any pertinent information on circumstances surrounding the incident or discovery. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species or preservation of biological materials from a dead fish, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

During the implementation of the proposed action, the FWHA shall coordinate with the Service to respond to any unforeseen effects, such as chemical spills or failure of the turbidity curtain. As part of meeting the reporting requirements of this Incidental Take Statement, FHWA shall provide the Service with an annual monitoring report due April 1 to report the progress of the action and its effects on the species for the term of this biological opinion. Upon completion of the proposed action, the FWHA shall provide confirmation that the proposed action was implemented as described herein.

16 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act requires Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service makes the following recommendation:

1. The FHWA should focus their 10.09 acre open water and emergent wetland mitigation site restoration on emergent wetlands because they are expected to provide the most benefit to larval and juvenile suckers.
2. The use of upright snag should be discouraged in the wetland mitigation site restoration plans as several species of piscivorous birds that prey on suckers use snags as perches. Throughout the range of the species there are numerous species of piscivorous birds, including terns, grebes, and mergansers, that may prey on adult, juvenile, and larvae suckers.
3. The FHWA should maximize the complexity of the mitigation site and Howard Bay shoreline to improve long-term benefits. A more complex habitat structure (e.g., vegetation or rocky substrates) is thought to provide more cover for fish, and it often increases growth or survival (Strayer and Findlay 2010, p. 132-133).

17 RE-INTIATION OF CONSULTATION

This concludes formal consultation pursuant to the regulations implementing the Endangered Species Act, 50 C.F.R. §402.16. Re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

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19 APPENDIX 1

APPROACH FOR ESTIMATING NUMERS OF LOST RIVER AND SHORTNOSE SUCKER

The Service is using data from juvenile sucker surveys completed from 1995 to 2009 in Howard Bay to estimate the number of Lost River and shortnose sucker potentially impacted by the FHWA proposed Project. The 1995 to 2009 data are from surveys conducted by Oregon State University, Department of Fisheries and Wildlife (Corvallis, Oregon) and were collected using a standardized sampling methods at fixed locations around Upper Klamath Lake. The Service considers the 1995 to 2009 data as the best available information to estimate numbers of Lost River and shortnose suckers potentially affected by the proposed Project in Howard Bay because data were collected in Howard Bay.

Amount and extent of Take in Action Area

Timing of proposed Howard Bay in-water construction (July 1 – January 31) may coincide with times when juvenile Lost River and shortnose sucker are present in the action area. However, based on the life history of the suckers, timing, and location of construction no eggs, larvae, or adults are expected to be present (see sections 6.5 – 6.8 habitats for each life stage).

To estimate the number of juvenile sucker that may be affected by the proposed Project, the Service relied upon data contained in the survey reports submitted to the Bureau of Reclamation Klamath Project (Simon et al. 2010). Although more recent surveys have been conducted (Simon, D. et al. 2013, Simon, D. et al. 2011, Simon, D. et al. 2014) the reports do not separate Howard Bay survey results from Upper Klamath Lake results. Therefore, Simon (2010) survey results are the most recent data available. The data from the Simon (2010) survey reports will likely result in an overestimate of take due to the need to adopt a worst-case scenario analysis. Another reason for the overestimation is due to another sucker species being present in the action area, Klamath largescale suckers (*Catostomus snyderi*); juveniles are indistinguishable from shortnose suckers based on non-lethal methods (Burdick 2017 p. 11). Identification of juvenile suckers to species requires collecting, transporting to a lab, and x-raying the suckers to count the number of vertebrae. Therefore, data presented in the Bureau of Reclamation Klamath Project survey reports list both Klamath largescale and shortnose suckers that have 44 vertebrae, as unidentified suckers during beach seine surveys (Simon 2010, p. 7). Previous studies that used morphological identification indicate that Klamath largescale suckers make up less than 10 percent of age-0 juvenile suckers captured in Upper Klamath Lake (Burdick, Summer M. et al. 2009, Burdick et al. 2008, Burdick and Brown 2010).

The 1995 to 2009 Lost River and shortnose sucker mean fish per net data are presented in table 1. These numbers can be used to estimate the number of suckers potentially affected by the proposed project in the action area. The Biological Assessment (FHWA 2018, entire) indicates there are 9.64 acres (39,011 m^2) of Lost River and shortnose sucker habitat in the action area that will be affected.

Take is anticipated from the installation of new embankment material. A turbidity curtain will be used and deployed in such a way that minimizes the potential for trapping suckers. Because there is no way to directly observe if all suckers are effectively excluded by the curtain, we assume that any fish caught behind the curtain will be affected by installation of new embankment material. Using the best available information on sucker densities from an area within Howard Bay, we can make a gross approximation of the number of suckers potentially affected along the impacted shoreline by multiplying the estimated density of juvenile suckers in similar shoreline habitats by the area over which suckers could potentially be harmed. We do not have any direct observations that can help us estimate the percentage of suckers that will be harmed by the additions of fill; therefore, we assume that all the suckers anticipated to be present in the area will be harmed, potentially lethally. However, this likely overestimates the take as most juvenile suckers are expected to leave the action area during late summer owing to poor water quality.

Estimated take in the action area based on 2009 data

Simon (2010) report abundance of juvenile suckers in catch per unit effort, based on a 6.1 meter (20 foot) beach seine with a sample area of approximately 29 meters squared (m^2) (314 ft^2). The mean age-0 juvenile sucker catch from beach seines conducted in Upper Klamath Lake in 2009 was 1.13 fish per net; while beach seines taken on the north shore of Howard Bay away from the highway had a mean of 0.5 fish per net, specific catches were generally zero with a few catches of 1-4 suckers per seine. A total of eight beach seine survey were conducted at each site in 2009. Based on these catches, density for both species combined was approximately 0.02 fish/m^2 in Howard Bay beach seine surveys. This estimate was calculated using the mean number of sucker per net and dividing that by the area sampled by the beach seine (29 m^2).

Assuming the above 2009 density, the total level of take would be equal to the area impacted (9.64 acres or 39,011 m^2) times the mean density of suckers (0.02 fish/m^2). Thus the estimated take is 0.02 suckers/m^2 x 39,011 m^2 = 780 suckers for mean Howard Bay take.

Estimated take in the action area based on 1995-2009 data.

Year	Juvenile sucker/net (mean)	Fish/m^2
1995-1998	7.5	0.26
1999-2003	1.73	0.06
2004-2008	0.3	0.01
2009	0.5	0.02

Table 1. Beach seine survey data from Howard Bay. Lost River and shortnose sucker populations have shown decline since 1995 based on annual reports submitted to the Bureau of Reclamation.

From 1995 to 2009 the number of age-0 suckers captured in Howard Bay declined substantially. This decline mirrors a decline in adult abundance in Upper Klamath Lake (Hewitt et al. 2018, p. 24-26) and has likely continued to the present. However, the data from 2009 are the most recent data available, and thus we assume that they are reasonably representative or an overestimate of the current conditions.

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